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# WDMUtil

Version 2.0

## A Tool for Managing Watershed Modeling Time-Series Data

### User's Manual

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# Disclaimer

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# User Assistance and Technical Support

EPA's Office of Science and Technology (OST) provides assistance and technical support to users of WDMUtil. Technical support can be obtained at OST's Internet Home Page. WDMUtil users are encouraged to access OST's home page for information on new updates, answers to the most frequently asked questions, user tips, and additional documentation.

EPA OST's Internet home page address: http://www.epa.gov/ost/basins

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# Introduction

## Background and Objectives

One of the abilities of the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) (Lahlou and others, 1998) tool is to perform nonpoint source modeling using the WinHSPF model. The WinHSPF model provides a Windows graphical user interface (GUI) to the Hydrologic Simulation Program-Fortran (HSPF) model (Bicknell and others, 1997). In order to successfully apply WinHSPF, meteorological data local to the area being studied are required. The current version of BASINS contains an average of 10 meteorological stations per state. These data are stored in the Watershed Data Management (WDM) format, which is used by both BASINS and HSPF. WDM files and the code library which manages them provide a powerful tool for managing and manipulating time-series data. However, to create and work with WDM files requires a significant level of user education. BASINS users would greatly benefit by having a straight forward, easy-to-use tool that would enable them to update or build WDM meteorological files without learning the detailed logistics of WDM operations. This tool is WDMUtil.

The goal of the WDMUtil program is to develop a utility which will allows users to import available meteorological data into WDM files and perform needed operations (e.g. editing, aggregation/disaggregation, filling missing data, etc.) to create the input time-series data for the HSPF model. WDMUtil will allow the user to add available local meteorological data to their study, thus removing the existing reliance on the limited set of meteorological data stored in BASINS.

# Capabilities

WDMUtil provides a variety of features to assist in the compilation of meteorological data for use by the BASINS and HSPF models. These include:

- reading time-series data from standard and user-defined formats,
- summarizing periods of missing or faulty data for a time series,
- listing time-series values for viewing, printing, and saving to a file,
- editing time-series values,
- generating time-series and comparison plots,
- computing new time-series data using existing data,
- disaggregating existing time-series data from daily to hourly values, and
- writing time-series data to WDM time-series data sets.

WDMUtil uses a graphical user interface and a context-sensitive help system to aid the user in performing these functions. It also allows the user to store data on WDM files without the user needing to understand the technical details of the WDM format.

Previously, these tasks were performed using DOS-based programs. Interfacing with WDM files was performed using the ANNIE (Flynn and others, 1995) and IOWDM (Lumb and others, 1990) programs (see http://water.usgs.gov/software/surface_water.html for links to these programs). Summarizing and correcting missing data, computing new data, and disaggregating data were performed using the METCMP program. It should be noted that WDMUtil does not contain all of the functionality housed in these programs. A recently developed tool, GenScn (A Tool for the Generation and Analysis of Model Simulation Scenarios for Watersheds) (Kittle and others, 1998), performs an expanded suite of utilities for analyzing time-series data.

# User Interface

## Graphical User Interface Conventions

WDMUtil was developed for user interaction to take place through a graphical user interface (GUI). Screens are organized in a logical manner to minimize both user learning time and user mouse/keystroke effort. Information within WDMUtil is often organized in layers, with the most basic and important information being readily available and more detailed and less frequently used information being accessed through additional menus or buttons. Another way that information may be layered is through the use of overlaid tabs, with the most frequently used tabs on top of the stack.

WDMUtil was also designed to assist the user in keeping track of where they are in the system. This was done by labeling all of the sub forms with titles that indicate the task being performed. This labeling also confirms to the user that they got to the right place in the system after selecting a menu option or button. The label on the main form is updated to include the name of the WDM file every time one is opened.

Selections from lists where more than one item may be selected is performed in the same manner as Windows 95/NT. Multiple selections are made using the Ctrl (control) and Shift keys on the keyboard. The Ctrl key is used to make multiple, but disjoint (not consecutive) selections. This is done by holding down the Ctrl key and clicking the desired items with the left button on the mouse. The Shift key is used to make multiple, consecutive selections. This is done by first selecting one item, using the left mouse button, at the start or end of the consecutive items to be selected. Then hold down the Shift key and select the other end of the consecutive items. All items between the first and second selection will be selected.

## Toolbars

Toolbars are used in WDMUtil to provide quick access to the most frequently used functions. Toolbar buttons contain tooltips, which provide a text description of each button when the mouse pointer is held over the button for a brief moment. Toolbars are provided on the main form of WDMUtil to work with the time-series buffer and the analysis tools.

## Grids

Grid controls are used in several places for displaying tabular data. In some grids an entire row is selected as a unit while others allow selection of individual cells. The text from currently selected cells can be copied to the clipboard by pressing Control-C. This text can be pasted into another grid, into a different part of the same grid, or into an external program such as Excel by selecting the target location and pressing Control-V. Data can be copied from an external program into an editable grid in the same way.

If the selected target location has fewer rows than the copied text, the last rows of the copied text will not be pasted. If the selected target location has more rows than the text that was copied, extra rows will be filled with additional copies of the text as necessary.

Some fields in some grids are editable. Some fields are edited by typing a new value and others are changed by selecting a new value from a drop-down list. To edit a field, select that field and press Enter or simply begin to type the new value. If a drop-down list appears, a selection can be made using the mouse or using the up and down arrows on the keyboard. Press Enter (or Tab) to finish editing the value or press Esc to revert to the old value.

Some editable fields have soft and/or hard limits for acceptable values. The tool tip feature displays these limits while editing a value. If a value being entered is outside the soft limits, the background of the cell will be colored yellow to alert the user, but no other actions are taken. If a value is outside the hard limits or is incorrectly formatted, the background will be colored red. If the user presses Enter while the background is red, the value is changed back to the last acceptable value.

## System Requirements

WDMUtil requires a computer running Windows 95, 98, or 2000; or Windows NT Version 4.0 or higher. The minimum platform configuration must contain:

- a 486 or equivalent processor running at 50 megahertz
- 16 megabytes of memory
- 40 megabytes of free disk space
- a display resolution of 1024 x 768

For optimal performance, a platform should contain:

- a Pentium or Pentium II processor running at 200 megahertz or faster
- 64 megabytes of memory

A color printer is also recommended.

## Obtaining WDMUtil

WDMUtil may be obtained through the Internet by accessing the EPA OST's Internet home page (at: http://www.epa.gov/ost/basins). From this page follow the instructions for downloading the software and installing it on your machine.

# Architecture

A successful user interface for managing watershed modeling data displays information to the watershed modeler in a manner consistent with the modeler's world view and needs. The goal of the interface is to provide layers of information -- a summary of information about the project in the main form along with other forms that show additional information. This includes details about the data and methods for analyzing it.

The WDMUtil user interface has a main form that displays lists of scenarios that have been collected (for observed data) or developed (for computed data), and locations and constituents for which data are available. From the main form the user may analyze results by selecting desired scenarios, locations, and constituents and then selecting the time-series data available. A span of time and the analysis tool(s) are then selected to generate the desired data summaries, graphs, or lists.

The design of reusable components has played a key role in the development of WDMUtil. The result of using these components includes (1) reusability within WDMUtil (references from different locations or with different parameter sets), (2) reusability within other modeling systems, and (3) more easily defined and tested modules. Reusable components in WDMUtil include the date setting control, the range-checking numeric entry box, the editable spreadsheet-style grid, the file viewing form, and the graphs. A significant effort has been invested in developing a suite of modules for the graphical and tabular display of time-series data and other analysis results. The modules allow the programmer to set initial values for the parameters that define the plot or listing (for example, data values, number of curves/columns, text labels). All plots and listings can be customized by the end user.

Since WDMUtil is focused on working with WDM data, it uses the WDM FORTRAN library of subroutines for time-series management. A set of subroutines was developed to interface between the Visual Basic WDMUtil code and the existing FORTRAN routines. This allowed the well-tested and documented WDM code to be preserved. It is necessary for WDMUtil to incorporate different types of time-series data (that is, storage formats). To make WDMUtil work with these different data types in a consistent manner, a generic data structure was developed. Specific routines for each data type were written to fill the data structure. WDMUtil was then able to use this data structure in the same manner for all types of data.

## Special Files

There are a variety of files either used by or associated with WDMUtil that should be noted. The Appendix provides detailed descriptions of each of these files and their contents. The following is a list of the files documented in the Appendix:

- Time-Series WDM - *.wdm, contains meteorological time-series data in format used by BASINS and HSPF,
- Summary of WDMUtil Data Import Scripts,
- WDMUtil Message WDM, contains essential information for WDMUtil to manage WDM files.

## Sample Data

Sample data have been provided with the WDMUtil installation package for learning and demonstration purposes. The *sample.wdm* and other complimentary files reside in the *sample* directory, which may be found in the directory in which WDMUtil was installed.

Although this sample WDM file was extracted from an original BASINS WDM file, it is only a subset of that WDM file and it has been modified for the purposes of the examples. No assumptions are to be made concerning the accuracy of the data on the sample WDM file.

# Tutorial

This section presents detailed examples illustrating the use of WDMUtil in various project situations. The most effective way to use this section is by running WDMUtil and working through the lessons. This assumes that WDMUtil and its sample data have been installed on your computer. For instructions on how to obtain and install WDMUtil, see Section 1.5, Obtaining WDMUtil. The contents of the forms displayed in the tutorial documentation may vary slightly with what appears in the forms as the lessons are run. This is due to some of the lessons creating new time series and is dependent on the order in which the lessons are performed. It is recommended that if you may want to rerun the lessons in the future, that you make a copy of the *sample.wdm* file before starting the lessons.

The lessons are intentionally basic to demonstrate how to perform functions. They also assume some familiarity with the topics being addressed. If you need more information than given in the lessons, detailed descriptions of the lesson topics may be found in other sections of the manual.

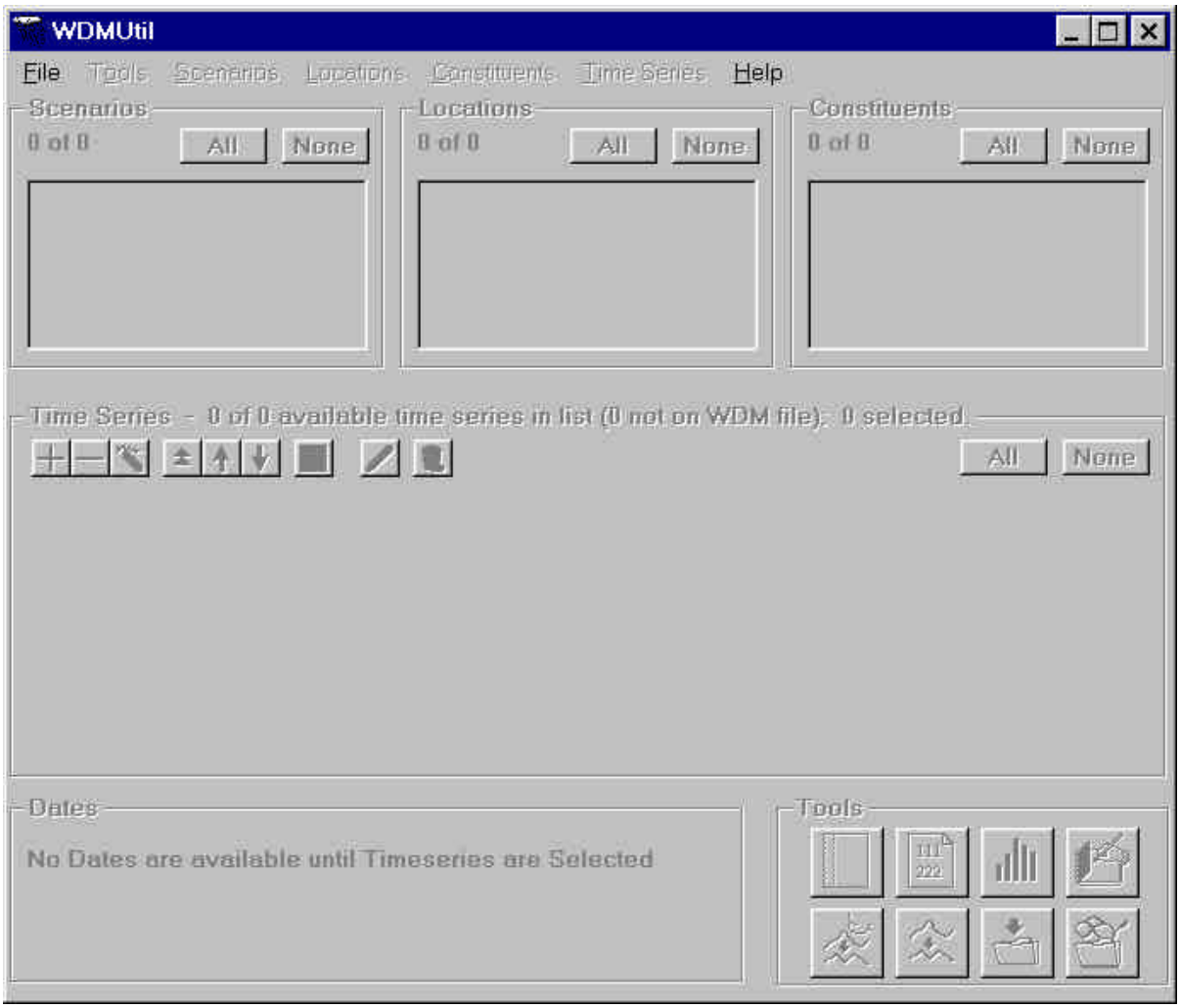
The lessons cover such general topics as becoming familiar with the basic mechanics of WDMUtil, accessing new data and saving it on a WDM file, using tools that may be needed to refine data, and building a WDM file from scratch.

The specific tasks shown in each lesson are:

- Lesson 1 - introduction to WDMUtil and time-series selection.
- Lesson 2 - importing external data to a WDM file.
- Lesson 3 - summarizing data and reporting missing values.
- Lesson 4 - listing and editing time-series data.
- Lesson 5 - creating various time-series plots.
- Lesson 6 - computing new time series from existing ones.
- Lesson 7 - disaggregating existing time series into new ones.
- Lesson 8 - building a new WDM file.

# Lesson 1: Introduction, WDM Open, and Time-Series Selection

In this lesson, WDMUtil will be started and a WDM file opened. The main WDMUtil form will be explored along with the help system. Exercises will then show different methods for selecting time-series data of interest for further review and analysis. Upon starting WDMUtil, the main form appears:



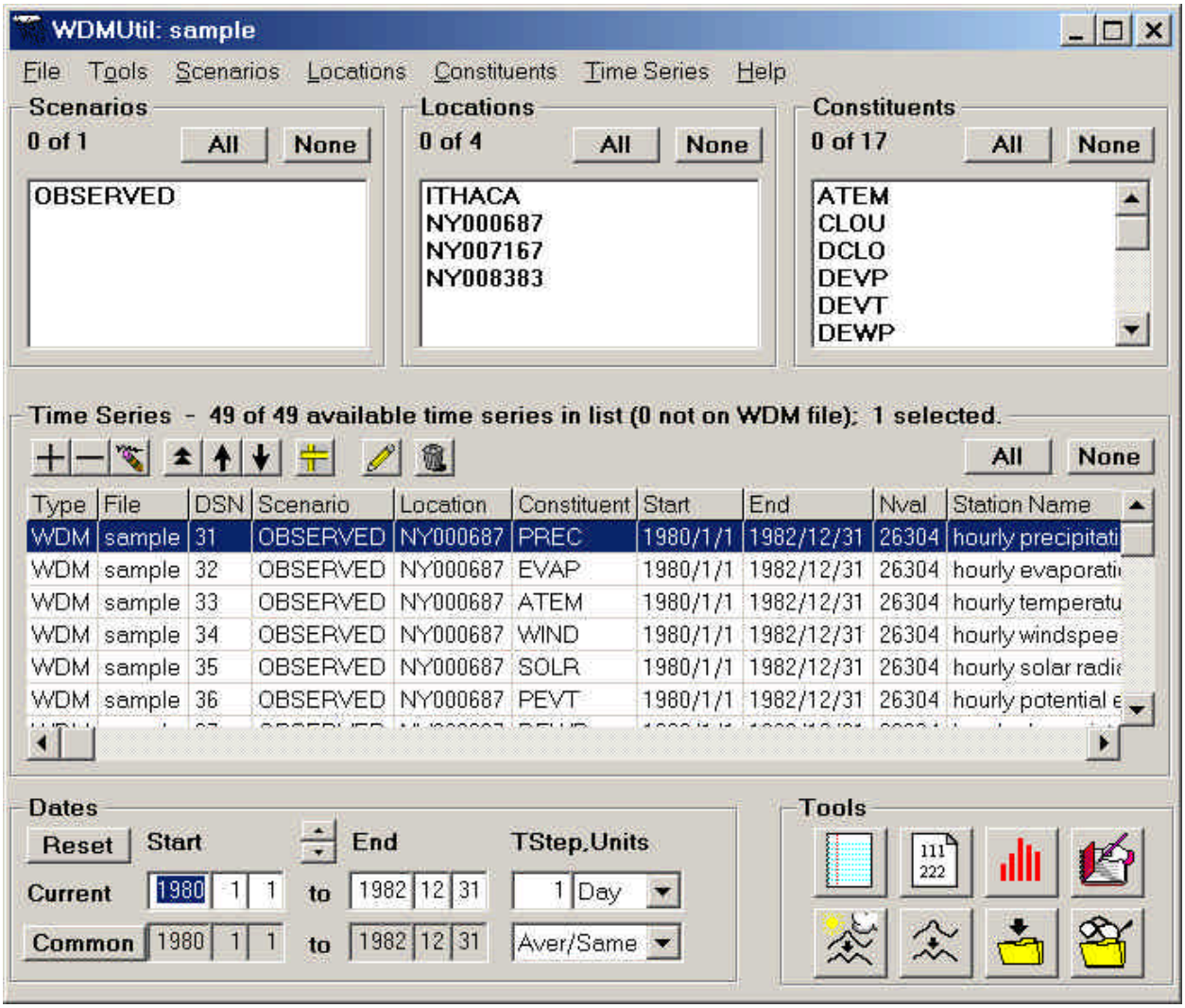

The main WDMUtil form is divided into a menu bar and six frames including Scenarios, Locations, Constituents, Time Series, Dates, and Tools. Each of the six frames is named in the upper left corner.

At any time when WDMUtil is being run, the complete manual is available online. To access the manual, simply press the F1 key. This command brings up the WDMUtil online manual open to a section appropriate to the current situation.

*Key Steps to Open an existing WDM file:*

1. Select the *Open* menu item from the File menu.
2. Select the *Sample* folder to move to the sample data directory.
3. Select *sample.wdm* to open the sample WDM file.

The WDM file is read and the main WDMUtil form is updated with the sample data as shown:



The Scenarios, Locations, and Constituents frames contain lists of all scenarios, locations, and constituents found on the time series in the WDM file. When a WDM file is first opened, all of the time series on the WDM file are added to the list in the Time Series frame. This list displays information about the time series that meet the criteria in the Scenarios, Locations, and Constituents lists. This frame also contains a toolbar for managing the contents of the time-series list.

The Dates frame contains information about the range of dates available that is common to the currently selected time series. For our selected time series, data are available from January 1, 1980, to December 31, 1982.

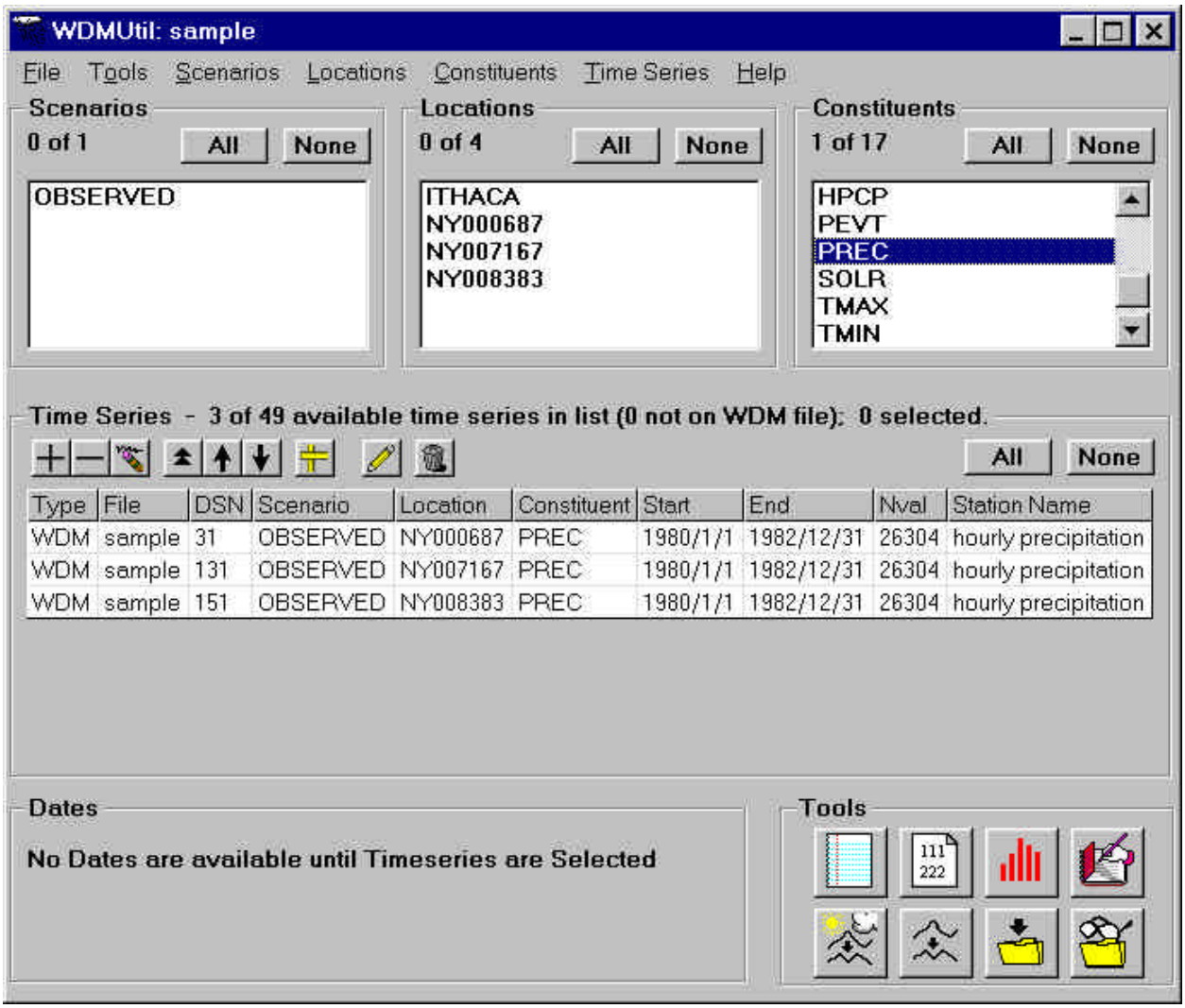
The Tools frame contains a toolbar that operates WDMUtil's analysis and computational tools. Later lessons will describe how to use these tools.

Between the **Scenarios**, **Locations**, and **Constituents** lists and the **Time Series** list, there is an invisible line, which may be used to resize these lists. This line is indicated by the mouse pointer changing to an up/down arrow when the pointer passes over the line. Resizing is performed by clicking on the line and dragging it up or down to adjust the list sizes as desired. Additionally, the entire main form of WDMUtil may be resized by dragging the edges of the form.

Resume this lesson by clearing the time-series list. This is done by clicking on the Clear button in the **Time Series** frame. The filtering capability of the **Scenarios**, **Locations**, and **Constituents** lists will now be demonstrated.

*Key steps to find which locations have precipitation data:*

1. If the time-series list is populated, clear it by clicking the Clear button.
2. Click on the *PREC* item in the **Constituents** list.
3. Leave the **Scenarios** and **Locations** lists with no selections (this is equivalent to selecting all items in those lists).
4. Click on the Add button in the **Time Series** frame.




Notice that only time series matching the criteria specified in the **Scenarios**, **Constituents**, and **Locations** lists were added to the time-series list and that all locations do contain precipitation data. Also note that since none of the time series are selected, no date information is available to display in the **Dates** frame.

In a similar manner, we could have determined what data is available at a specific location by selecting that location from the **Locations** list and leaving the **Scenarios** and **Constituents** lists with no selected items. Clicking the **Add** button would add time series that match the selected criteria to the time-series list.

From here, either proceed on to Lesson 2 or exit the program.

# Lesson 2: Importing External Data to a WDM File

This lesson will demonstrate the most fundamental need addressed by WDMUtil, that is, taking data not on a BASINS WDM file and adding it to that WDM file for use in BASINS. How to import data into WDMUtil and store it on a WDM file will be demonstrated. If you haven't already, begin this lesson by opening the *sample.wdm* file.

All time series are read into WDMUtil using a data import scripting language. A user interface, or wizard, for developing data import scripts is included in WDMUtil and will be shown later in this lesson. When a file is specified to be imported, a list of available scripts is displayed. If the user knows that a specific script will properly process the data being imported, as is usually indicated with a green highlight, they may select that script and run it to read the data. If no script exists for the data being imported, the wizard may be used to develop a new script or the user may develop the script with a text editor. Examples of importing data with an existing script and by developing a new script are shown here.

A common need in applying BASINS is to update existing WDM data with more recent values. For this example, we will import precipitation data and append it to an existing time series, ID number 201.

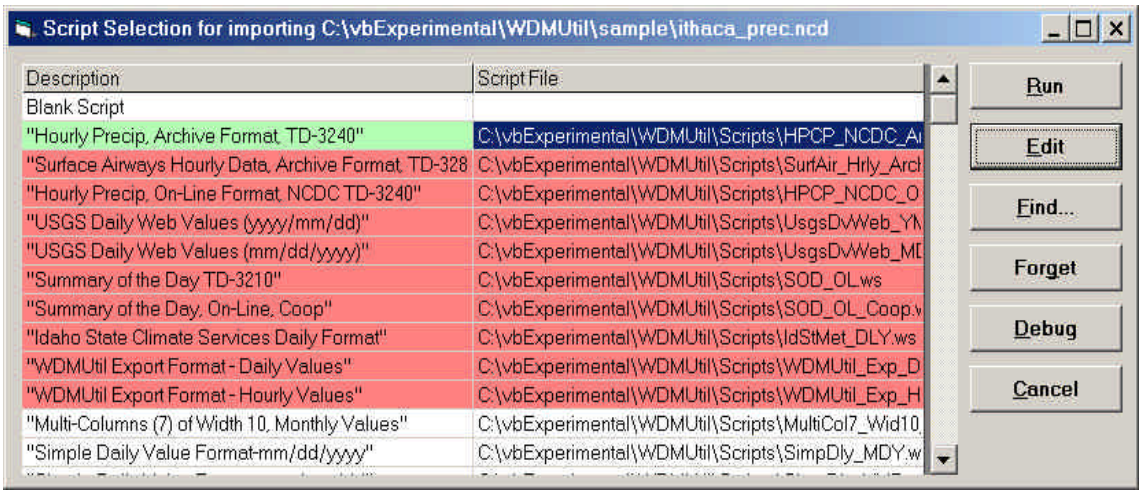
*Key steps to Import a time series for which a data import script exists:*

1. Begin the importing process by selecting the File:Import menu item.
2. From the **File Import** dialogue, select the NCDC export file named *ithaca_prec.ncd*.
3. If you have yet to import any data into WDMUtil, a message box will be displayed informing you of the need to load scripts into the system.

No Scripts Found Yet
Use the Find button to locate scripts.
Look for the Scripts directory where this program is installed.
OK

4. Loading scripts into WDMUtil is performed by clicking the **Find** button on the **Script Selection** form. Scripts distributed with WDMUtil can be found in the /scripts directory below the directory in which WDMUtil was installed. Click the **Find** button and in the

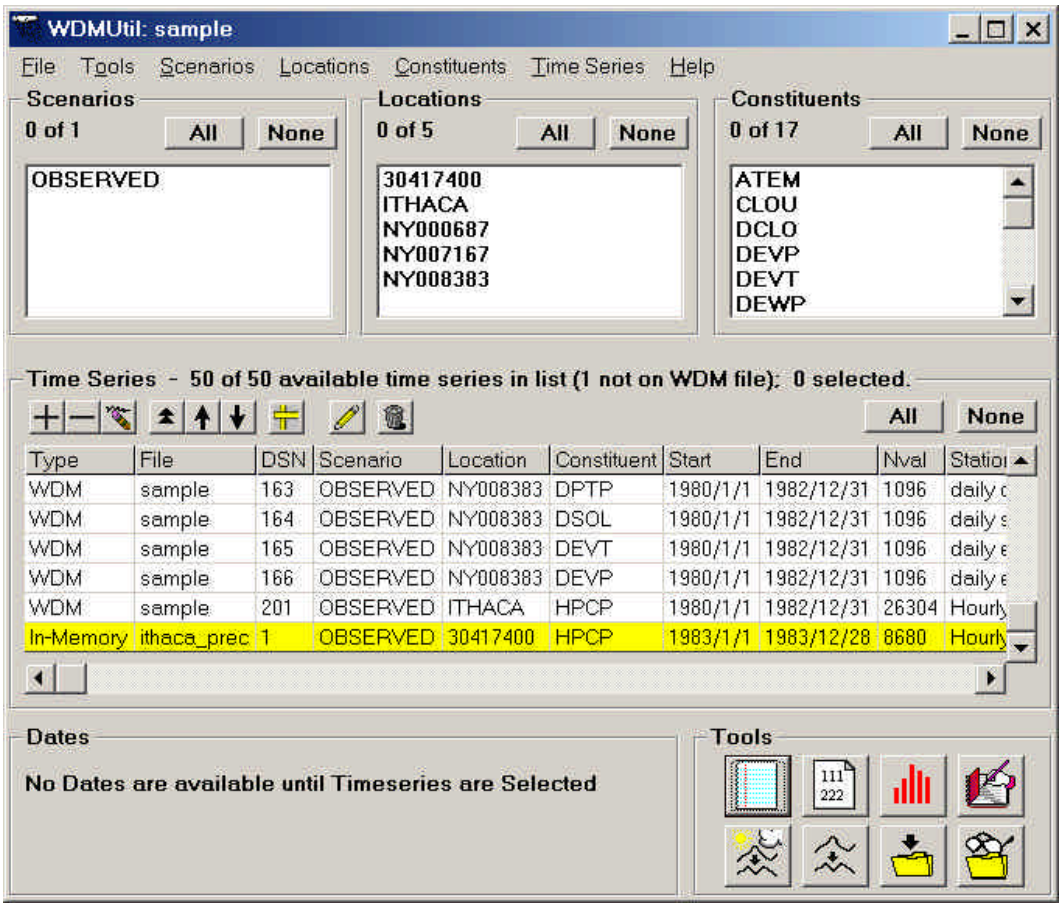
File Open dialogue move to the */scripts* directory. For this exercise, we will be using the script in the file *HPCP_NCDC_Arch.ws*, so select it from the dialogue.




5. From the Script Selection form, note that the *HPCP_NCDC_Arch.ws* script has a green background and is selected.

6. Click the **Run** button.

When it has finished reading the data, the **Wizard Script Selection** form will be closed and the main WDMUtil form will be displayed.




Note that the main form has been updated to reflect the newly read time series. Various elements of the **Time Series** frame have been updated, such as the counts of available time series and time series not on the WDM file, and the list of time series. Note that the new time series has a Type of *In-Memory* instead of *WDM* and that it is displayed in a color different from the WDM time series. This new time series is now available to WDMUtil, in the same manner as existing WDM time series, for analyses and computations. However, it is not yet saved on the WDM file.

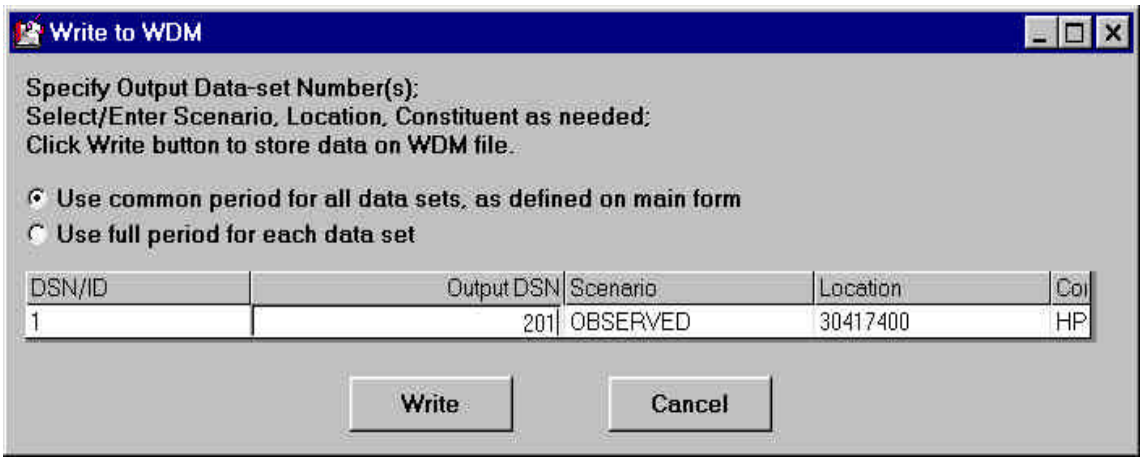
As with any computer work, saving should be performed when significant changes are made. In this case, we have gone through the effort of importing a time series. If this time series is to be stored on the WDM file, it is advisable to perform this operation now. If imported time series are not saved on the WDM file and WDMUtil is exited (or the WDM file is closed), a message box will be displayed confirming that the user wishes to exit without saving the data.

*Key steps to Save time series to a WDM file:*

1. Select the time series to be saved on the WDM file, in this case the *In-Memory* time series just imported.

2. Click the Write button in the Tools frame.

3. On the Write to WDM form, enter the ID number for the existing time series to which the newly imported data will be appended, ID number 201.




4. Click the **Write** button. Since the output time series already exists, a message box will ask what you would like to do with the data being saved. As we wish to append the new data to the existing time series, click the **Append** button.

5. A message box informs you that the data was successfully appended.

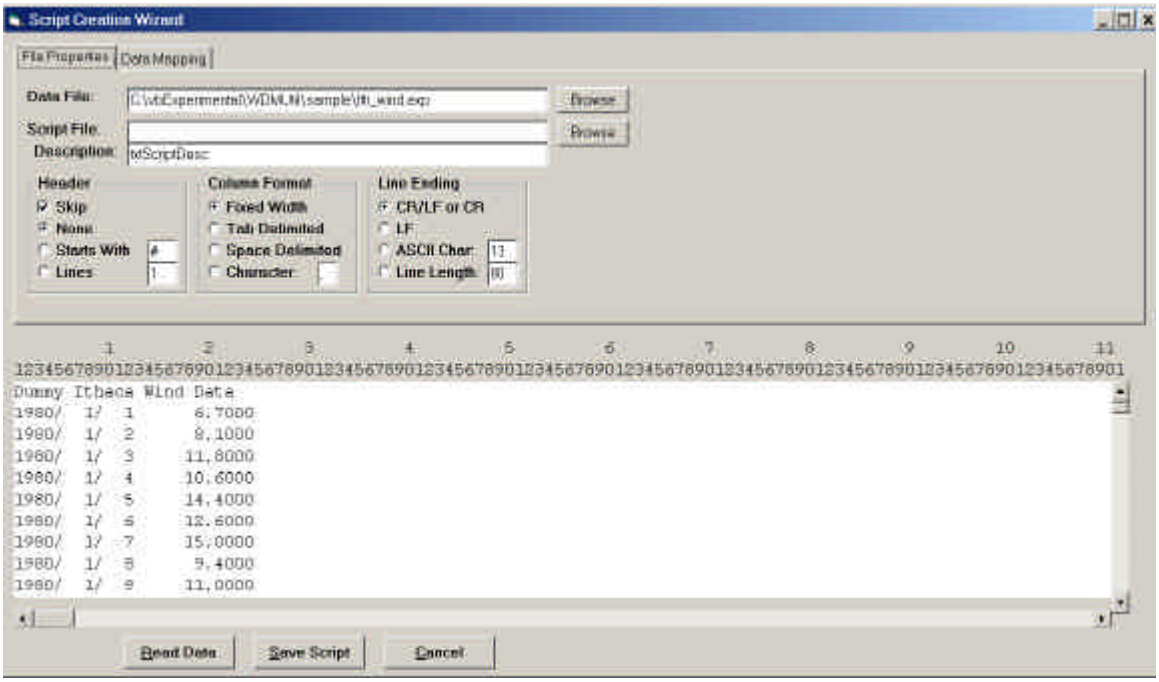
There is frequently a need for localized data when a study site is not near a station stored on the original BASINS WDM file. To continue the example, we will import some evaporation data for a new location. However, the data being imported is in a format that no existing script can process. In this case, we will have to develop a new script using the script wizard.

*Key steps to Import a time series for which no data import script exists:*

1. Begin the importing process by selecting the File:Import menu item.

2. From the **File Import** dialogue, select the file named *Ith_wind.exp*.

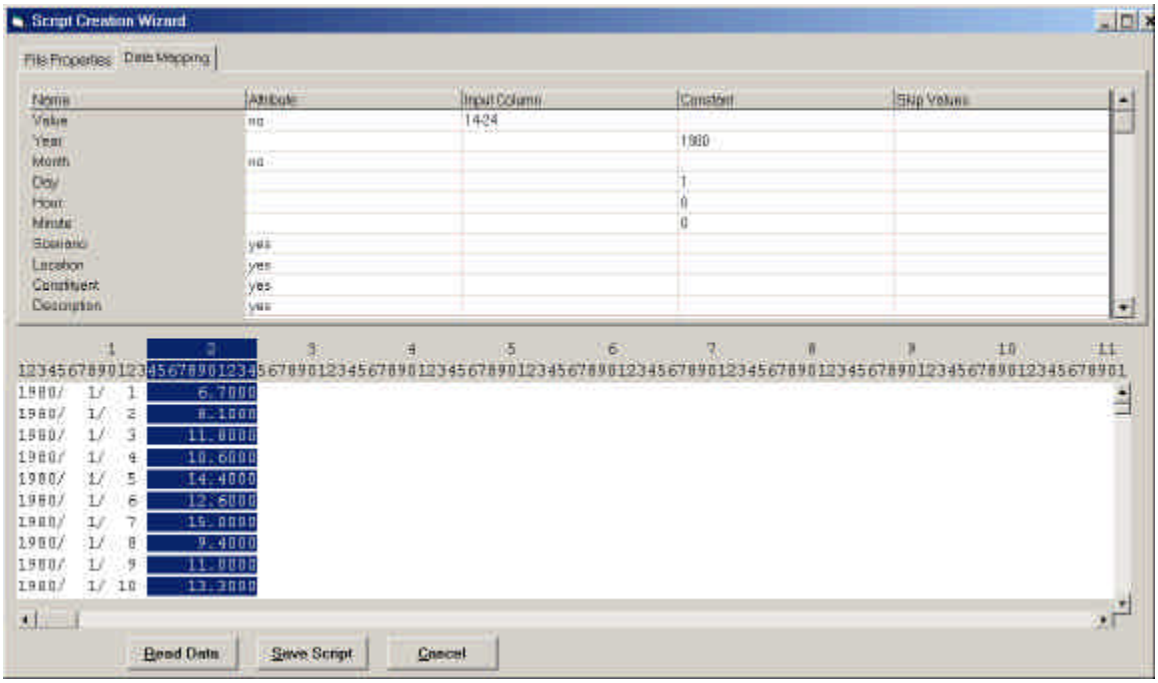
3. From the **Script Selection** form, select the *Blank Script* and then click the **Edit** button.




4. On the **Input Wizard** form, note the **Header** frame that is used to skip header lines at the start of a file. In this frame, click the *Lines* option and specify to skip 1 line.

5. The remaining frames, used to specify the *Column Format* and *Line Ending* properties, are defaulted to *Fixed Width* and *CR/LF* or *CR*, respectively. These are appropriate for the file being imported. Now click on the **Data Mapping** tab at the top of the form.

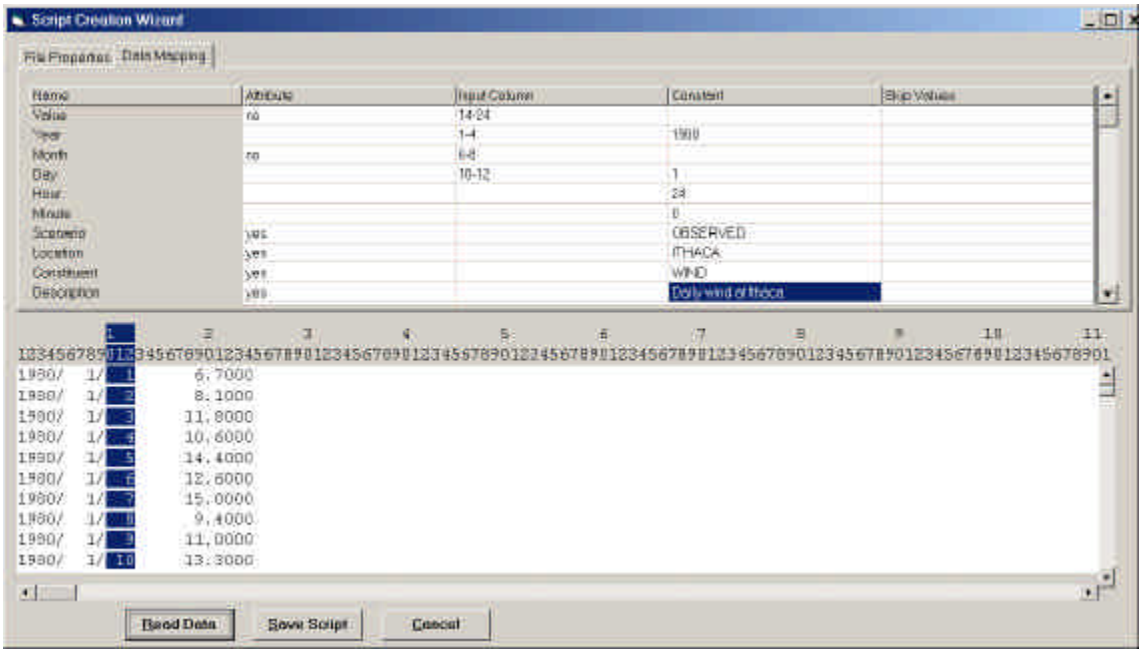
6. The list at the top of the **Data Mapping** tab contains names of various data elements used in importing data. On this list, click on *Value* to begin defining the columns in which the data values are found. Above the frame displaying the data file is a row of column numbers. These column numbers can be highlighted, by clicking and dragging with the mouse, to define the location of the data elements. Now define the location of the data values by highlighting columns 14 - 24. The *Input Column* numbers for the *Value* element will then be updated in the data elements list.




7. In the same manner, define the columns for the Year (1 - 4), Month (6 - 8), and Day (10 - 12) data elements.

8. Since these are daily data, set the *Hour* data element to a constant value of 24 by entering 24 under the *Constant* column.

9. For the *Scenario*, *Location*, *Constituent*, and *Description* elements, click under the *Constant* column and enter text descriptions for these elements (e.g. *OBSERVED*, *ITHACA*, *WIND*, *Daily wind at Ithaca*).




10. Clicking the **Save Script** button will allow you to store the script for future use.

11. Now import the data by clicking the **Read Data** button.

It is not necessary, but if you wish, you may write this newly imported time series to the WDM file using the **Write** tool as was done earlier in this lesson.

Note the following features of the Write to WDM form:

- When more than one time series is being saved, an option is provided to save only the data in the time period common to all time series or to save the full period of data for each time series.
- A row of descriptive fields is displayed for each time series being saved to the WDM file. The time series' current number (or ID), Scenario, Location, and Constituent are shown along with a field for entering the data-set number on which to store the data.
- Valid data-set numbers (1-9999) must be entered for each time series before writing to the WDM file.
- The Scenario, Location, and Constituent names may also be modified before writing, if desired.

From here, either proceed on to Lesson 3 or exit the program.

# Lesson 3: Summarizing Data

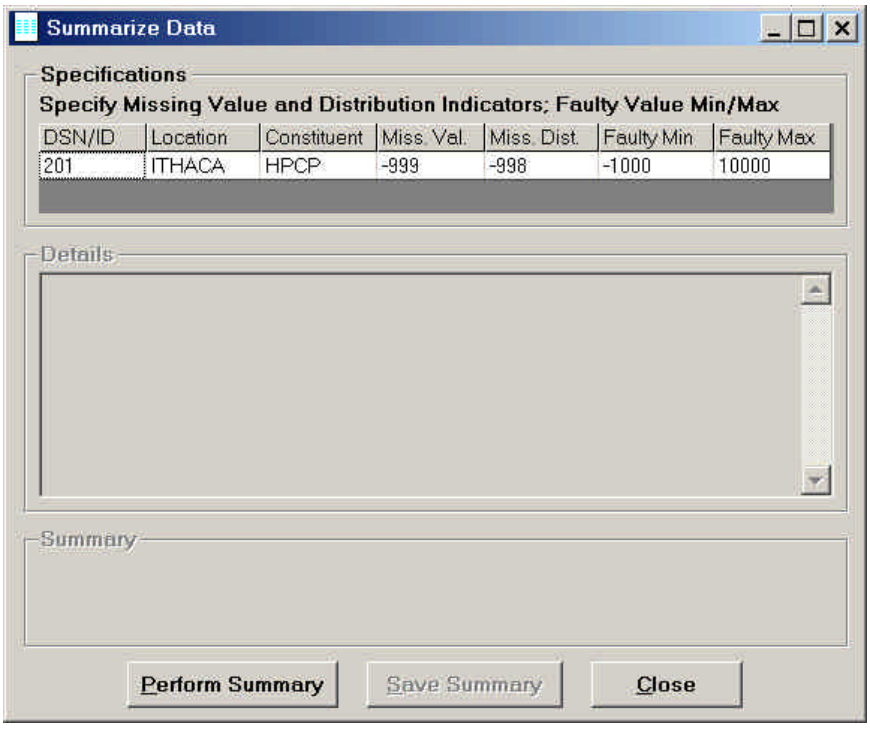
In this lesson the method for summarizing data and reporting missing, accumulated, or faulty values will be demonstrated. It is common to find missing or invalid values in recorded meteorological data. The Summarize tool helps a user to locate such values and determine their frequency.

If you are starting from scratch, start WDMUtil and open the *sample.wdm* file, (see Lesson 1 for how to do this).

In this lesson, missing data in precipitation time series will be summarized.

*Key steps to begin summarizing precipitation time series:*

1. If the time-series list is populated, clear it by clicking the Clear button.
2. Select only the *HPCP* item from the **Constituent** list.
3. Add the time series that matches these criteria by clicking the Add button.
4. Select the time series in the time-series list.
5. Click the **Summarize** button in the **Tools** frame.

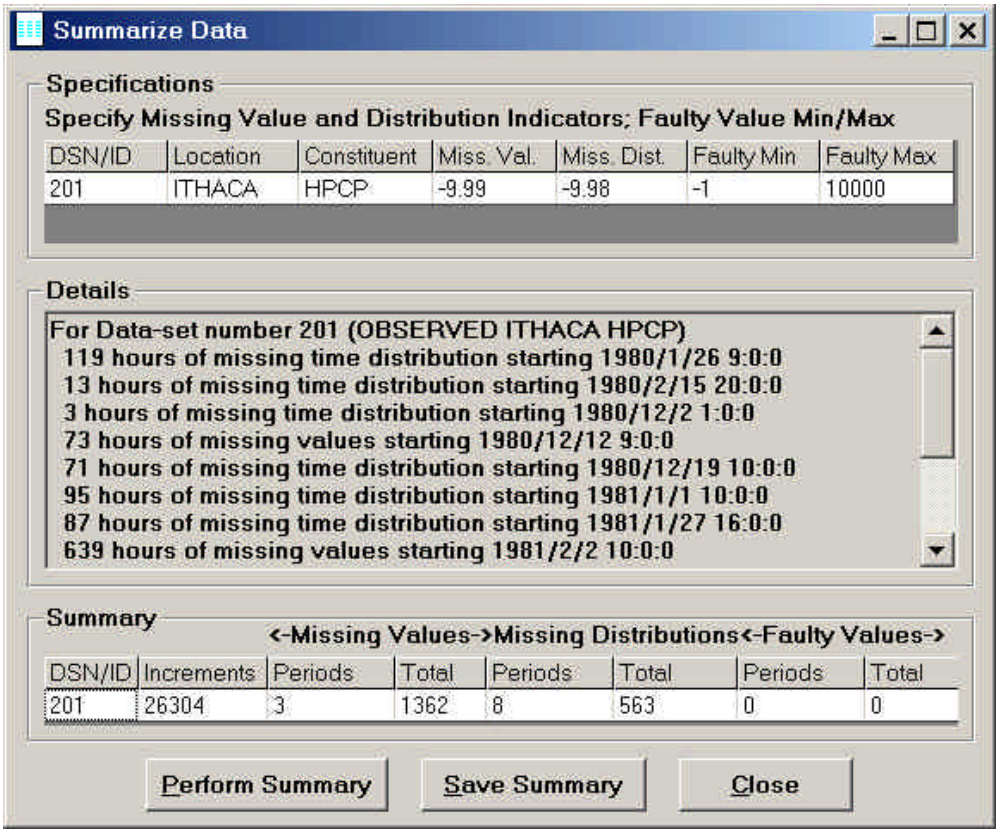


For the data used in this exercise, it is known that our missing value indicator is -9.99 and our missing time distribution indicator is -9.98. These are common values for precipitation data. For other meteorologic data, missing values are often indicated by a value of -999.

*Key Steps to Perform Summary of the time series:*

1. Modify the values in the **Specifications** frame as needed: *Miss. Val.* = -9.99, *Miss. Dist.* = -9.98, *Faulty Min* = -1, *Faulty Max* = 10000.

2. Click the **Perform Summary** button.


Summarize Data
Specifications
Specify Missing Value and Distribution Indicators; Faulty Value Min/Max
DSN/ID Location Constituent Miss. Val. Miss. Dist. Faulty Min Faulty Max
201 ITHACA HPCP -9.99 -9.98 -1 10000
Details
For Data-set number 201 (OBSERVED ITHACA HPCP)
119 hours of missing time distribution starting 1980/1/26 9:0:0
13 hours of missing time distribution starting 1980/2/15 20:0:0
3 hours of missing time distribution starting 1980/12/2 1:0:0
73 hours of missing values starting 1980/12/12 9:0:0
71 hours of missing time distribution starting 1980/12/19 10:0:0
95 hours of missing time distribution starting 1981/1/1 10:0:0
87 hours of missing time distribution starting 1981/1/27 16:0:0
639 hours of missing values starting 1981/2/2 10:0:0
Summary
<-Missing Values->Missing Distributions<-Faulty Values->
DSN/ID Increments Periods Total Periods Total Periods Total
201 26304 3 1362 8 563 0 0
Perform Summary
Save Summary
Close

The **Details** frame displays a list of each missing data period, the date and time that it starts, and the number of time intervals in it. The **Summary** frame displays total number of periods and time increments of missing values, missing distributions, and faulty values.

If desired, the **Save Summary** button may be used to output the contents of the **Details** and **Summary** frames to a file for future viewing or printing.

The following lesson (Time-Series Listing and Editing) will demonstrate how to list time series with missing values along-side time series with good values and how to edit these missing values.

# Lesson 4: Time-Series Listing and Editing

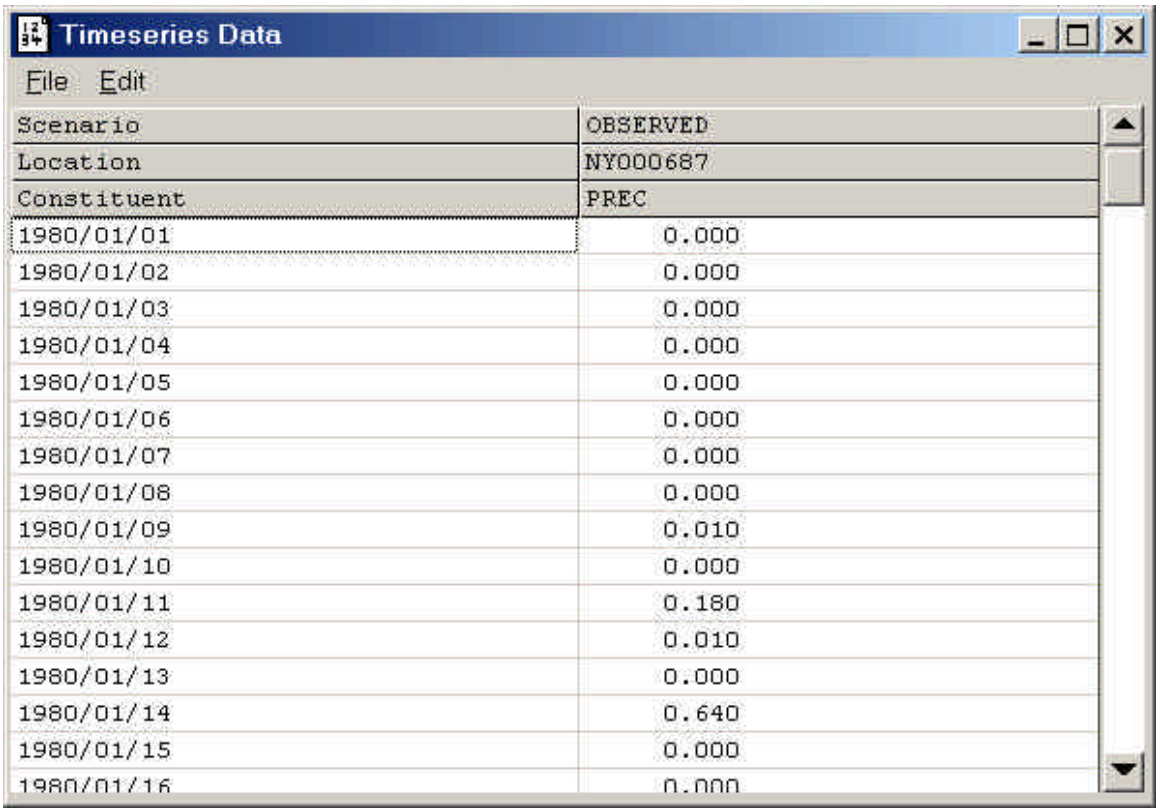
In this lesson, some of WDMUtil's time-series listing capabilities will be demonstrated. The listing tool is useful for performing quality assurance checks on data. The summary capabilities, demonstrated in this lesson, enhance the list tool's ability to assist in quality assurance. Additionally, the ability to edit listed time-series values will be demonstrated. A portion of the missing data identified in Lesson 3 will be listed and amended.

If not already running WDMUtil with the sample data, start WDMUtil and open the *sample.wdm* file (see Lesson 1 to learn how to do this). We will list the observed precipitation data at NY000687, or time-series number 31, which is hourly data. However, as a quality assurance check without looking at every hourly value, we will list the daily sums of this time series' values to look for any abnormal daily totals.

*Key steps to generating a daily listing of hourly data values:*

1. If the time-series list is populated, clear it by clicking the Clear
2. Click on the *OBSERVED* item in the **Scenarios** list.
3. Click on *NY00687* in the **Locations** list.
4. Click on the *PREC* item in the **Constituents** list.
5. Click on the Add button in the **Time Series** frame.
6. Select the lone time series from the list
7. Change the list in the lower right corner of the Dates frame from *Native* to *Sum/Div*.
8. Change the **TStep and Units** in the **Dates** frame to 1 and *Day*, respectively.
9. Click the **List**

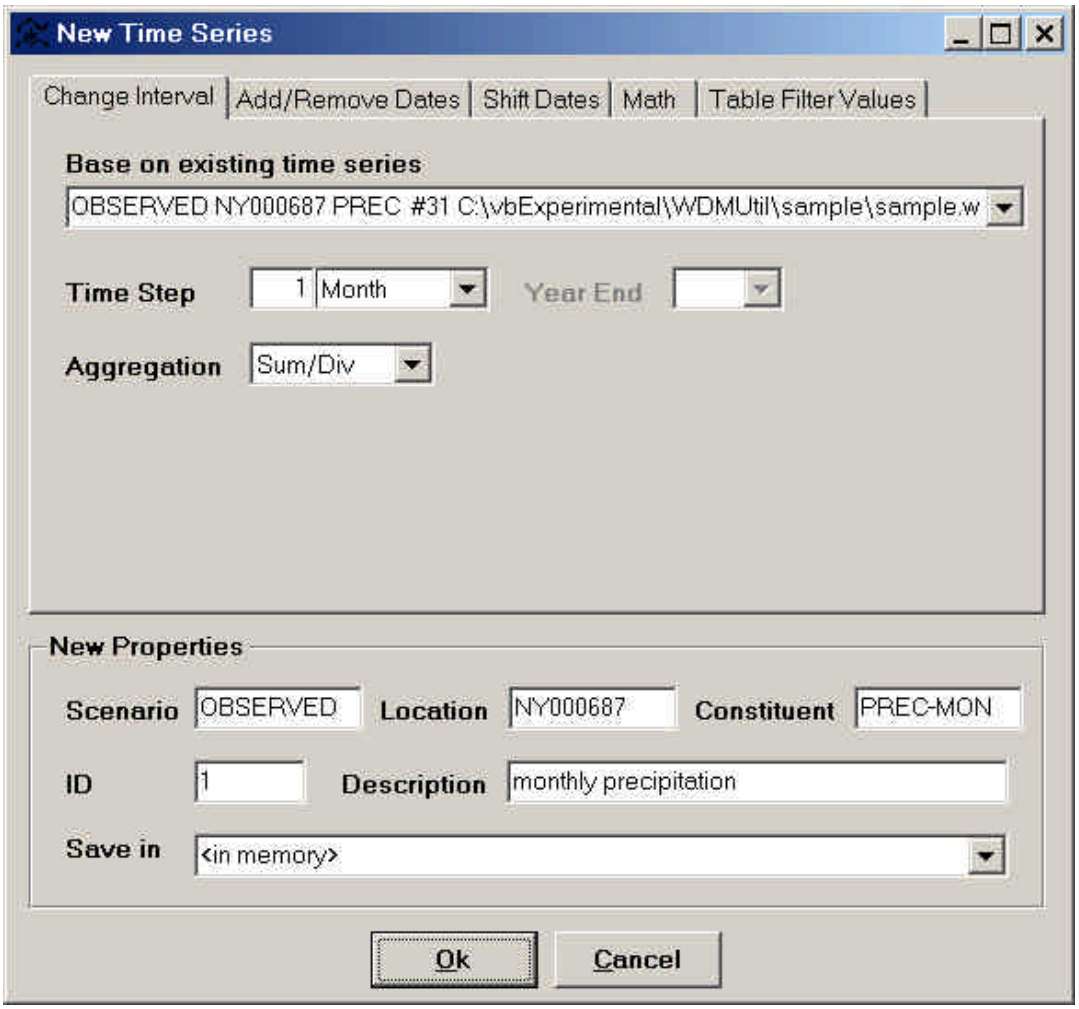
button in the Tools frame.



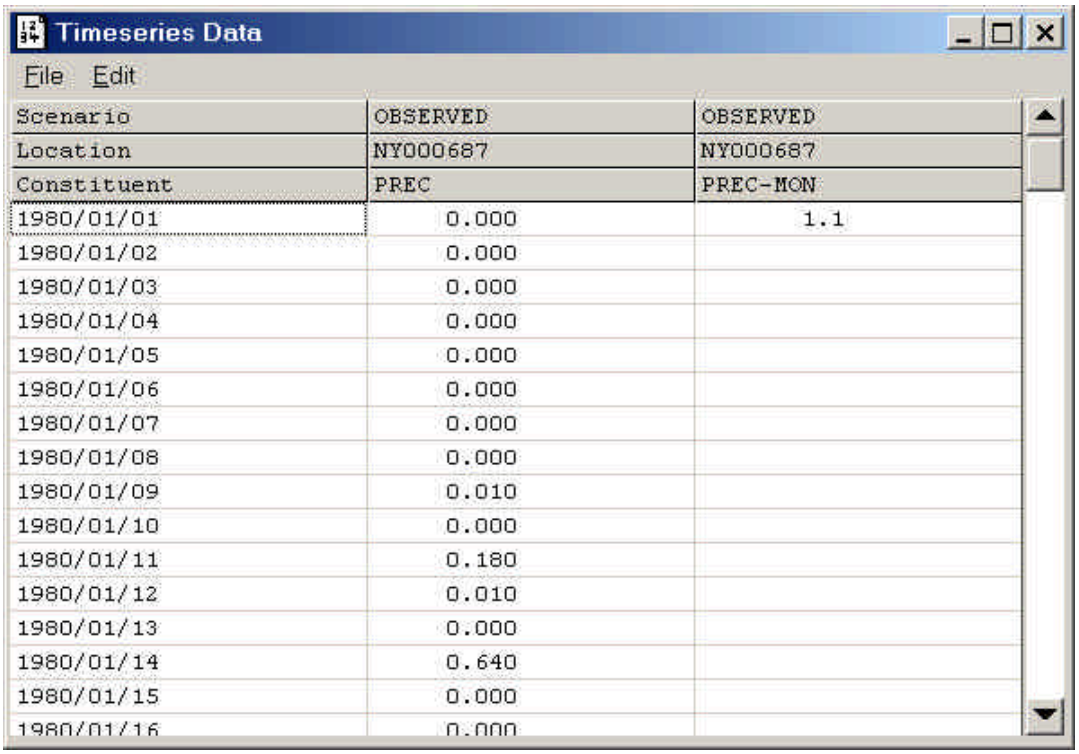

As an additional quality assurance check, we will now add monthly totals to our existing list.

*Key steps to create a monthly observed precipitation time series:*

1. Select the **New Time Series** item from the File menu on the **Time Series Data** form
2. On the **New Time Series** form:
   - set the **Time Step** to 1 *Month*
   - set the Aggregation to *Sum/Div*
   - addend *-MON* to the **Constituent** field
   - change the **Description** to *monthly precipitation*
   - choose *In-Memory* from the **Save in** list box
3. press the OK button on the **New Time Series** form




Note that the newly created time series of monthly totals is now listed next to the original observed precipitation data on the **Time Series Data** form. Also note that the newly created monthly time series will be available in WDMUtil even after the list is closed. This new time series will be "In-Memory", not on the WDM file, and it need not be saved.



Timeseries Data

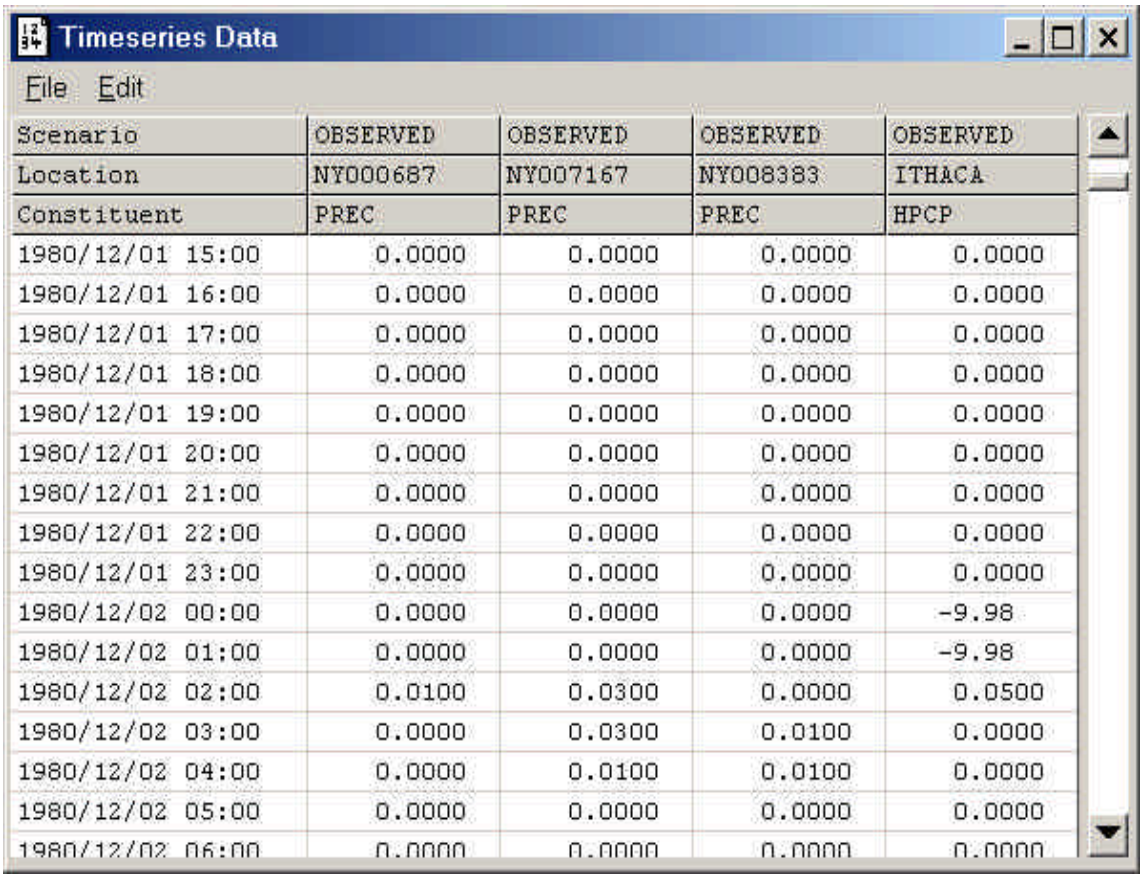
File Edit

| Scenario | OBSERVED | OBSERVED |
|---|---|---|
| Location | NY000687 | NY000687 |
| Constituent | PREC | PREC-MON |
| 1980/01/01 | 0.000 | 1.1 |
| 1980/01/02 | 0.000 | |
| 1980/01/03 | 0.000 | |
| 1980/01/04 | 0.000 | |
| 1980/01/05 | 0.000 | |
| 1980/01/06 | 0.000 | |
| 1980/01/07 | 0.000 | |
| 1980/01/08 | 0.000 | |
| 1980/01/09 | 0.010 | |
| 1980/01/10 | 0.000 | |
| 1980/01/11 | 0.180 | |
| 1980/01/12 | 0.010 | |
| 1980/01/13 | 0.000 | |
| 1980/01/14 | 0.640 | |
| 1980/01/15 | 0.000 | |
| 1980/01/16 | 0.000 | |

The **List** tool may also be used to edit missing or faulty data values. For this example we will be correcting some missing data on time-series number 201 that was identified in Lesson 3.

*Key steps to edit time-series data values:*

1. Clear all time series from the time-series list and then select both the *HPCP* and *PREC* items from the **Constituent** list. Click the Add button. There should be four time series added to the time-series list.
2. Click on all of the items in the time-series list to select them for listing.
3. Set the start date to 1980/12/1 and the end date to 1980/12/31.
4. Since we will be editing values, we want to make sure we are listing the data at its actual time interval. Select the *Native* item from the list in the lower right corner of the **Dates** frame.
5. Click the **List** button to generate the time-series listing and then scroll down to December 2nd.



Timeseries Data

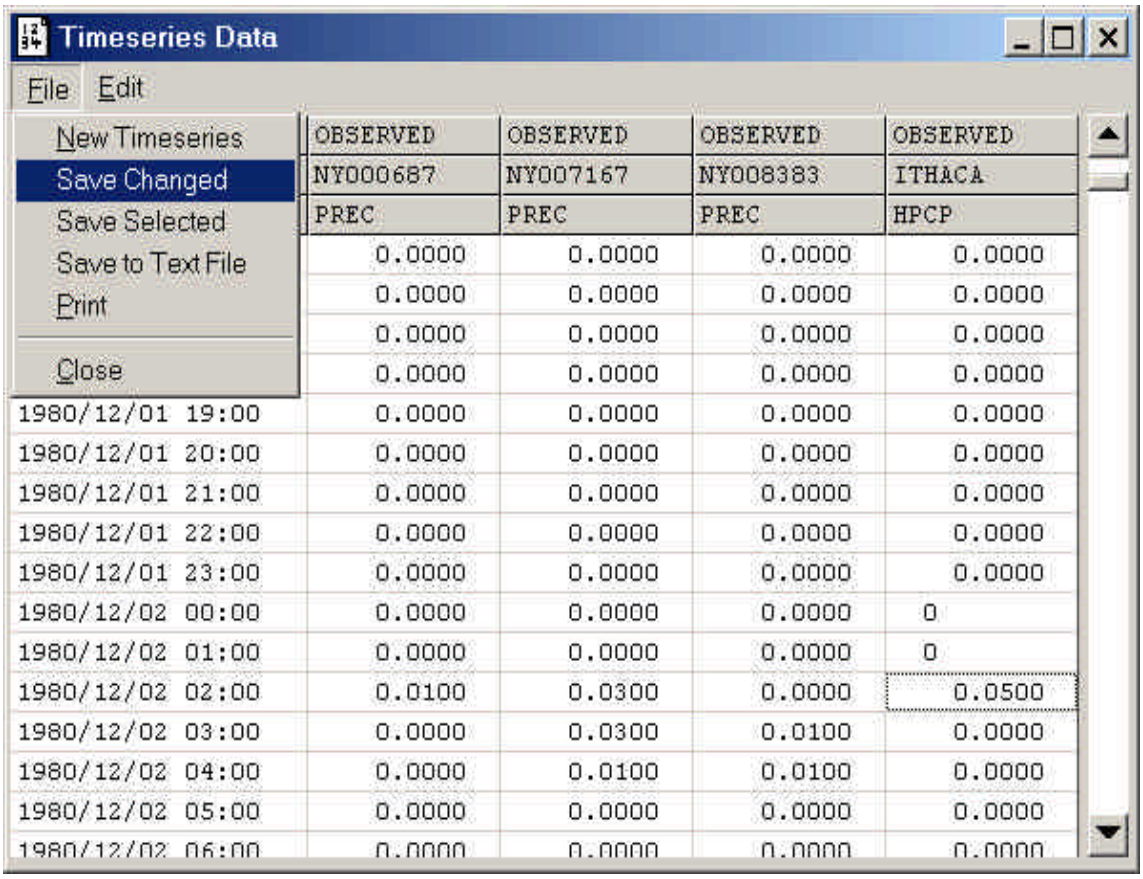
File Edit

| Scenario | OBSERVED | OBSERVED | OBSERVED | OBSERVED |
|---|---|---|---|---|
| Location | NY000687 | NY007167 | NY008383 | ITHACA |
| Constituent | PREC | PREC | PREC | HPCP |
| 1980/12/01 15:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 16:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 17:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 18:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 19:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 20:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 21:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 22:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/01 23:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/02 00:00 | 0.0000 | 0.0000 | 0.0000 | -9.98 |
| 1980/12/02 01:00 | 0.0000 | 0.0000 | 0.0000 | -9.98 |
| 1980/12/02 02:00 | 0.0100 | 0.0300 | 0.0000 | 0.0500 |
| 1980/12/02 03:00 | 0.0000 | 0.0300 | 0.0100 | 0.0000 |
| 1980/12/02 04:00 | 0.0000 | 0.0100 | 0.0100 | 0.0000 |
| 1980/12/02 05:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 1980/12/02 06:00 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

6. Note that the first two hours of December 2nd for the *ITHACA* location contain values of -9.98, which was set as the default value to indicate missing time distributions in Lesson 3. The 3rd hour's value is 0.05 indicating that the reading measured 0.05 at that hour, but the event(s) could have occurred any time during the past 3 hours.

7. Based on the values of the nearby stations, it is likely that the event did occur during the 3rd hour. Therefore, the first 2 values on the 2nd can be set to 0 and the 3rd hour's value can be left as 0.05.

8. For the purpose of this lesson, it is not necessary to save the edited values. If you did wish to save the edited valus back to the WDM file, the **Save Changed** option from the File menu would be used. WDMUtil would then prompt you for a time-series number to which the edited values would be saved.




**Note: When saving edited time series, only the period of record in the list will be saved. Therefore, if the whole period of the original time series is to be preserved after editing, the entire period of the time series should be listed.**

9. Close the **Time Series Data** form and click the Yes button when asked about discarding edited values.

From here, either proceed on to Lesson 5 or exit the program.

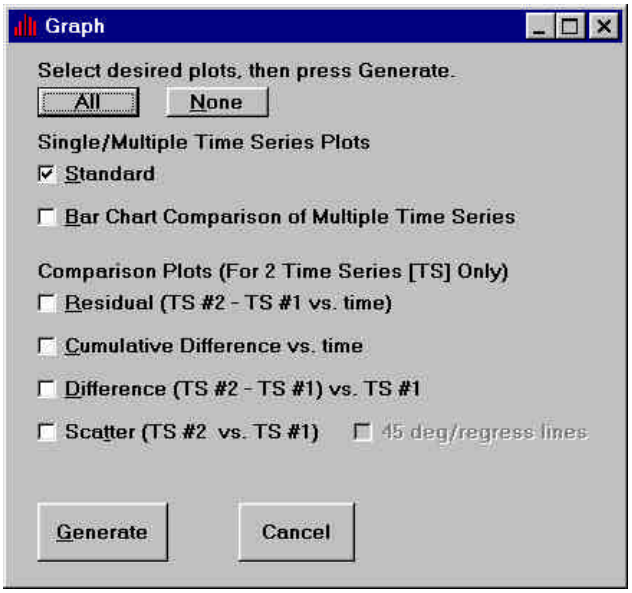
# Lesson 5: Time-Series Graphics

In this lesson, some of WDMUtil's time-series graphics capabilities will be demonstrated. The Graph tool provides a suite of plots for graphically viewing time-series data. This lesson will use a standard time-series plot to compare two related time series' values over time.

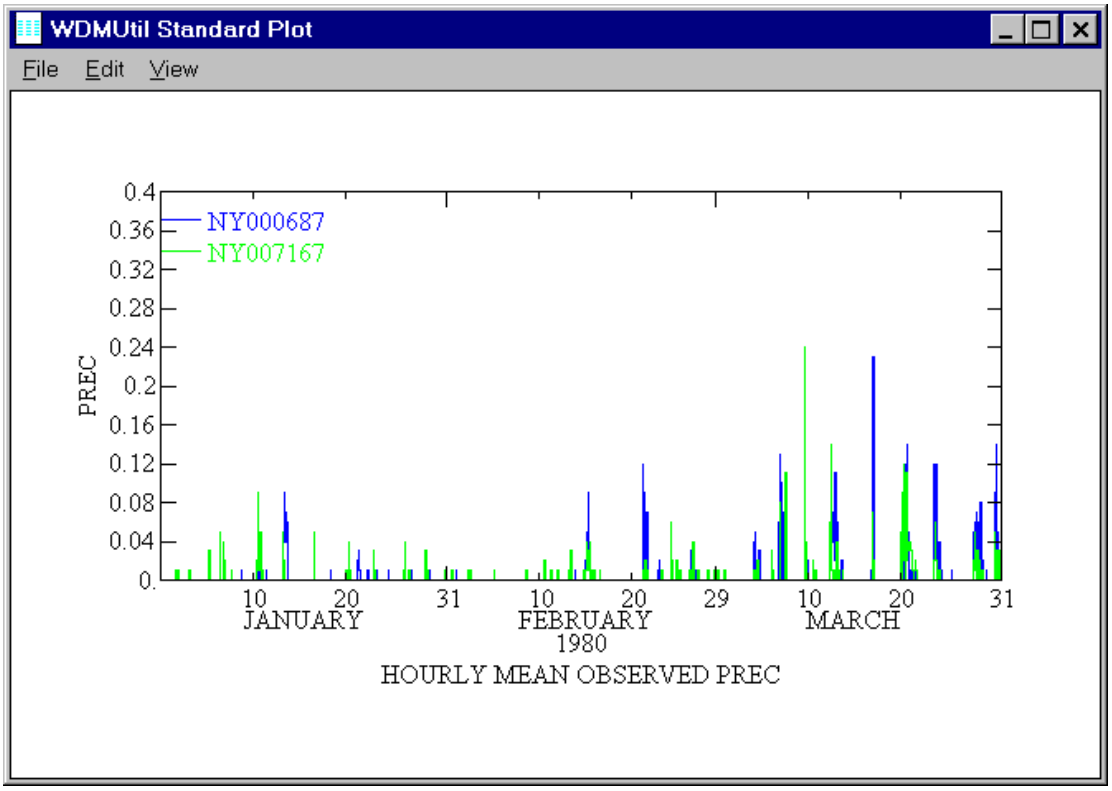
If not already running WDMUtil with the sample data, start WDMUtil and open the *sample.wdm* file (see Lesson 1 to learn how to do this). We will plot the first two hourly precipitation (PREC) time series in the Time Series list, numbers 31 and 131. (If these time series are not in the list, clear the list using the **Clear** button, select all items in the **Scenario**, **Location**, and **Constituent** lists, and then add all the time series using the **Add** button).

*Key steps to Generate a standard time series plot:*

1. Select the time series to be plotted from the time-series list. Do so by finding the first time series (number 31) and clicking on it. Then find the second time series (number 131) and while holding down the Ctrl key, click on it.
2. Since this is hourly data, we will only plot the first three months. So change the change the starting date to 1/1/1980 and the ending data to 3/31/1980 in the Dates frame.
3. Either set the **TUnits** list to *Hour* or set the list in the lower right corner of the Dates frame to *Native*.
4. Click the **Graph** button in the Tools frame.


Graph
Select desired plots, then press Generate.
All
None
Single/Multiple Time Series Plots
Standard
Bar Chart Comparison of Multiple Time Series
Comparison Plots (For 2 Time Series [TS] Only)
Residual (TS #2 - TS #1 vs. time)
Cumulative Difference vs. time
Difference (TS #2 - TS #1) vs. TS #1
Scatter (TS #2 vs. TS #1)
45 deg/regress lines
Generate
Cancel

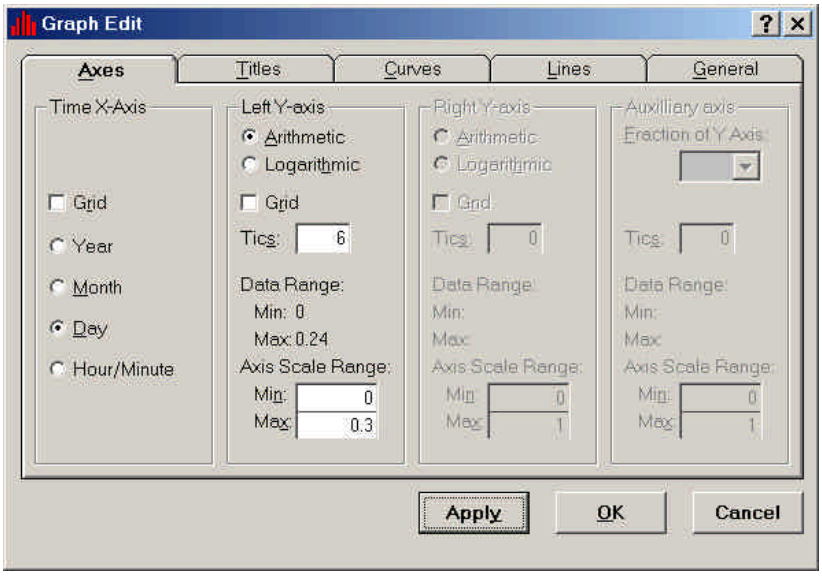
5. For this lesson, we will only be generating the Standard time-series plot. Click the **Generate** button to create the plot.




From this point, most of the items on the plot may be customized as desired. This is done through the use of the Edit menu, which has options for modifying *Axes*, *Titles*, *Curves*, *General information*, and *Lines*. Besides using the Edit menu, many of these modifications may be initiated by clicking on the item to be changed.

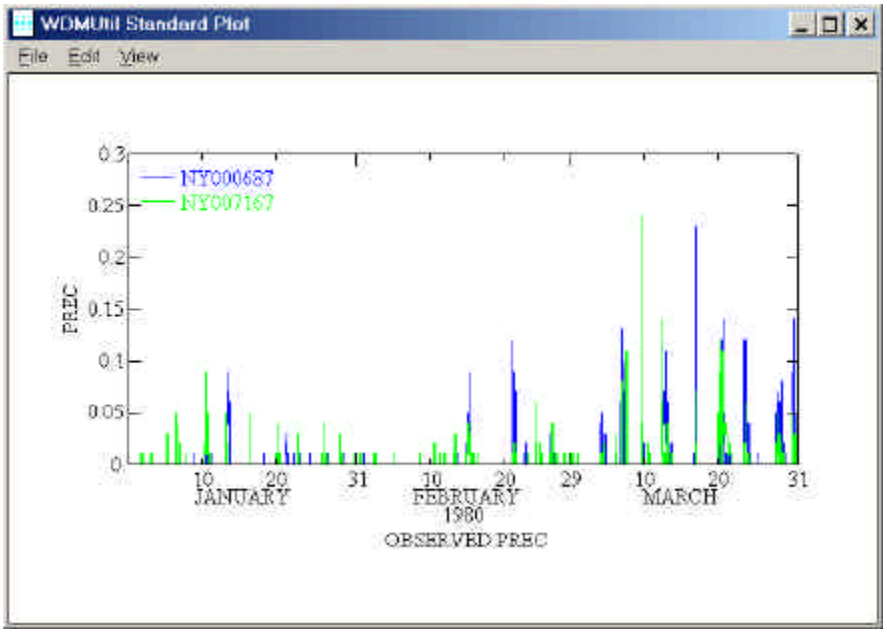
*Key steps to Modify an existing graph's axes:*

1. Either select the *Edit:Axis* menu item or click on the top or bottom X-axis. The **Graph Edit** form to appear with the **Axes** tab at the front.




2. To have the curves use more of the available plotting space, change the *Axis Scale Range:*, *Max:* value from 0.4 to 0.3. Also change the number of tics from 10 to 6 to have round numbers on the tic labels.

3. Now click the OK button and the plot will be redrawn with the modified Y-axis scale.




Close the **Plot** form by clicking the *X* in the upper right corner (or by selecting the *File:Close* menu item). Also close the **Graph** form by clicking the Cancel button. From here, either proceed on to Lesson 6 or exit the program.

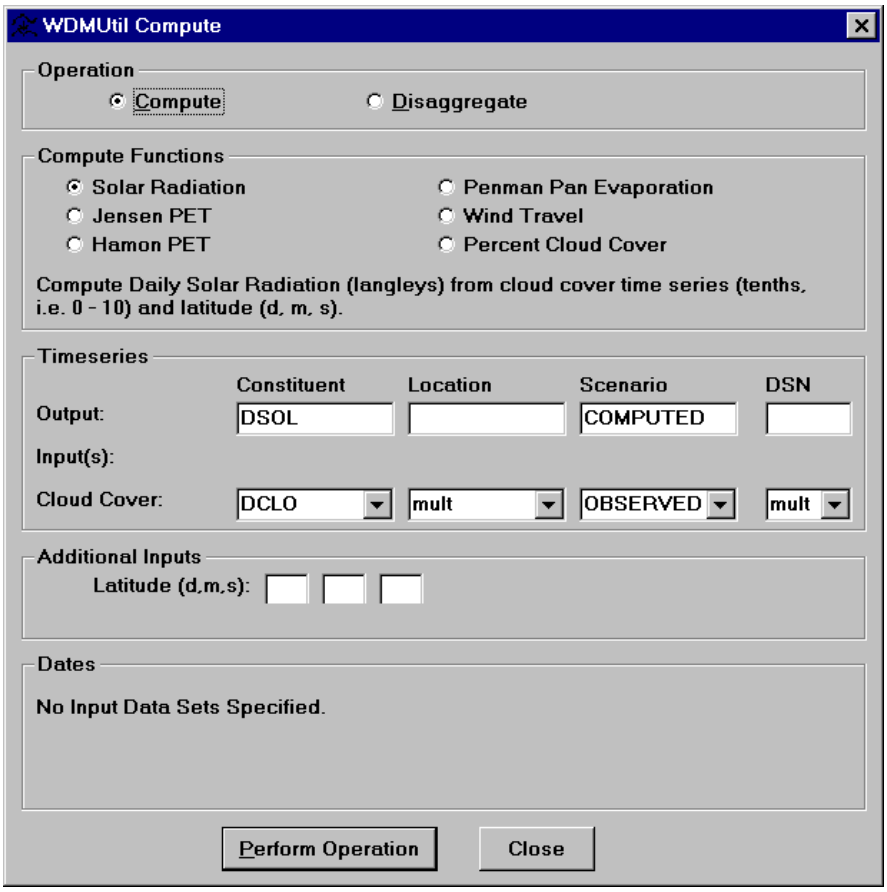
# Lesson 6: Computing New Time Series

In this lesson, the ability to compute new meteorological time-series data from existing data will be demonstrated. When developing a BASINS study for a local area that is not near an existing BASINS WDM location, it is common to have a limited set of meteorological data available. The Compute functions provide alternative methods for developing the meteorological constituents needed for use in BASINS. In this lesson we will demonstrate how to compute Solar Radiation time-series data.

If not already running WDMUtil with the sample data, start WDMUtil and open the *sample.wdm* file (see Lesson 1 to learn how to do this).

*Key steps to Compute a Solar Radiation time series:*

1. Click on the **Compute** button in the Tools frame and the Compute form will be displayed.

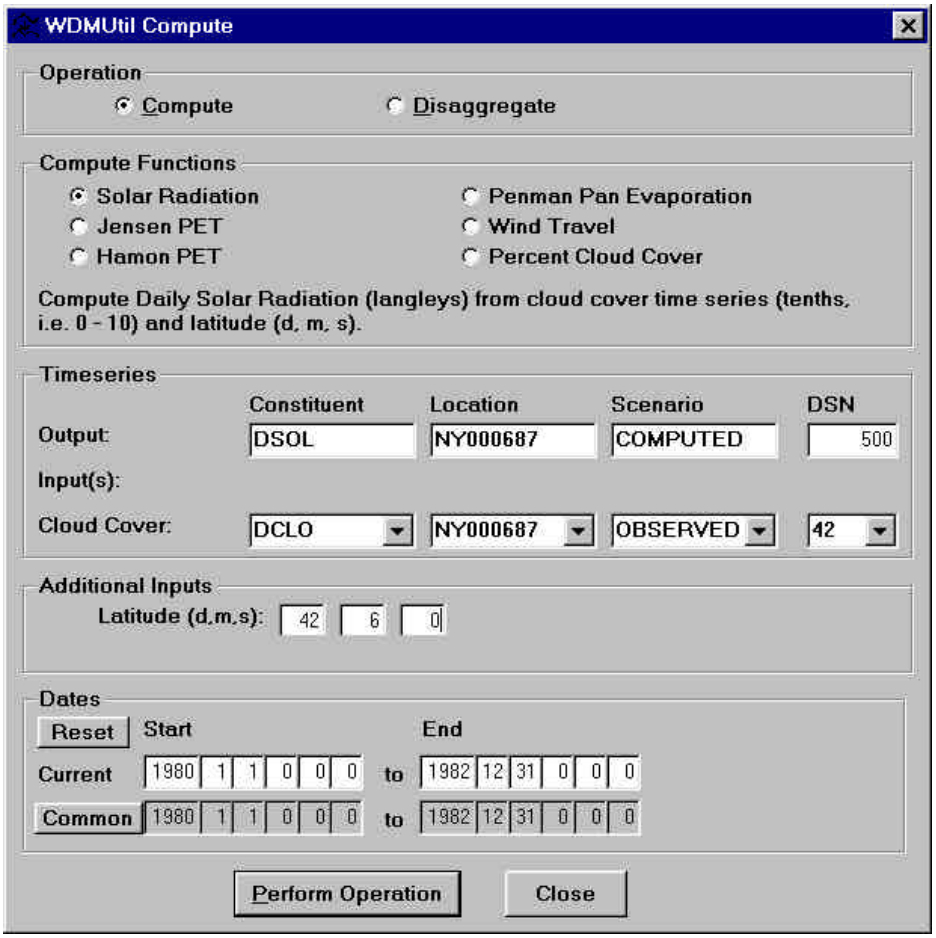


2. For each of the six **Compute Functions**, the **Time Series** frame prompts for the needed input and output time series. As indicated, the input data needed to compute *Solar Radiation* is *Cloud Cover*. Leave the input time series' constituent name as the default, *DCLO*.

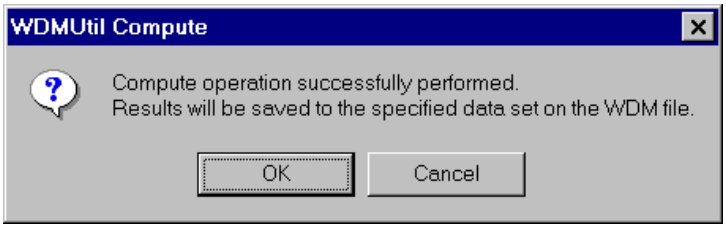
3. Click on the **Constituent** list, initially shown as *mult*. The *mult* indicates that there is more than one location that has daily cloud cover data. From the **Locations** list select the location *NY000687*.

4. The combination of Constituent *DCLO*, Location *NY000687*, and Scenario *OBSERVED* uniquely identifies time series number 42, as is displayed in the **DSN** (data-set or time series number) list. As the input time series specifications were made, default values for the output time series have been supplied. The only remaining item to be specified for the output time series is its number. Enter 500 in the text field for output DSN.

5. The only required information remaining to be specified is the longitude of the location. Enter 42, 6, and 0 in the three fields for defining the location's longitude.



6. Click the **Perform Operation** button. A message box will be displayed indicating that the operation was successful and asking to confirm that the computed data should be stored on the designated output time series.

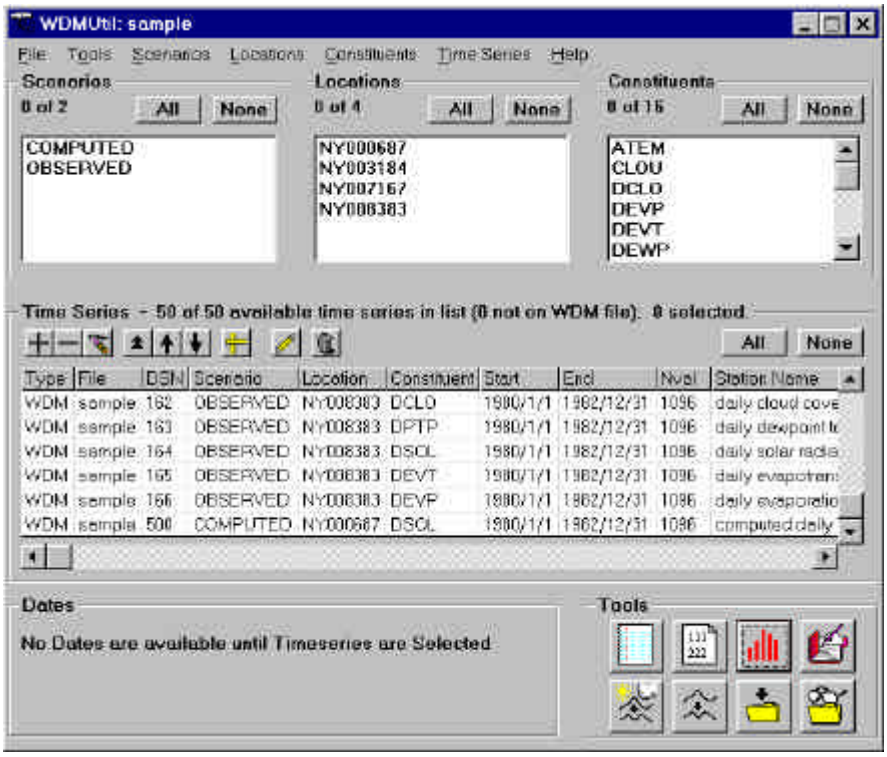

WDMUtil Compute
Compute operation successfully performed.
Results will be saved to the specified data set on the WDM file.
OK
Cancel

7. Click the OK button on this message box.

8. Click the OK button on the ensuing message box reporting that the data set was successfully stored on the WDM file.

9. Click the Close button on the **Compute** form.

Note that the main form has been updated to include the newly computed time series.




A second item (*COMPUTED*) has been added to the **Scenarios** list since the newly computed time series' scenario name was *COMPUTED*. Scrolling to the bottom of the list in the **Time Series** frame will display the new time series. From here, either proceed on to Lesson 7 or exit the program.

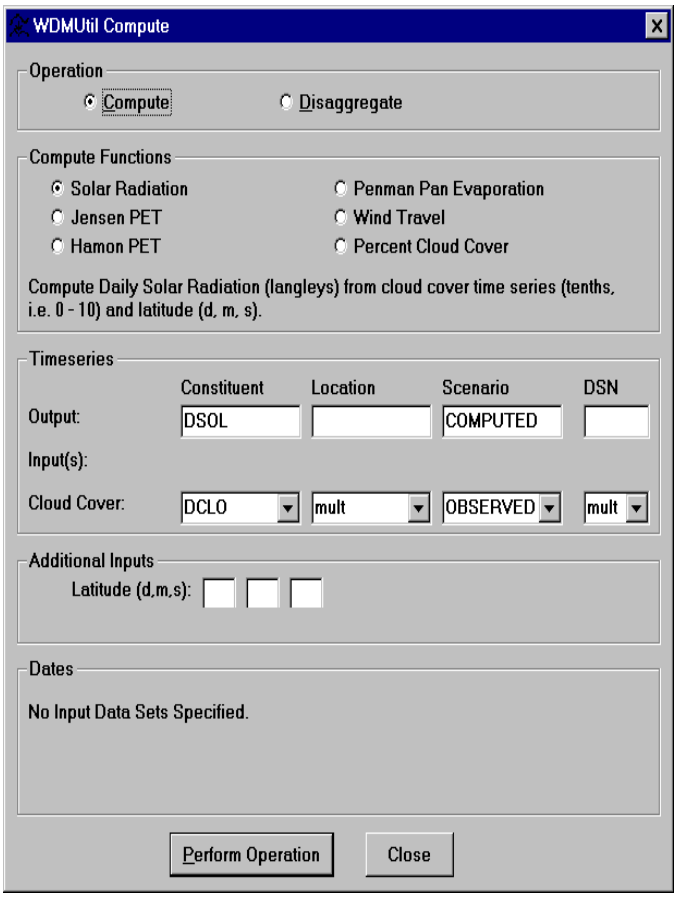
# Lesson 7: Disaggregating Time Series

In this lesson, the ability to disaggregate existing meteorological time-series data to a new time series will be demonstrated. When developing a BASINS study for a local area that is not near an existing BASINS WDM location, it is common to have a limited set of meteorological data available. Additionally, there is frequently even less available data at the hourly time step required by BASINS. The **Disaggregate** functions provide alternative methods for developing the hourly meteorological data needed for use in BASINS.

If not already running WDMUtil with the sample data, start WDMUtil and open the *sample.wdm* file (see Lesson 1 to learn how to do this).

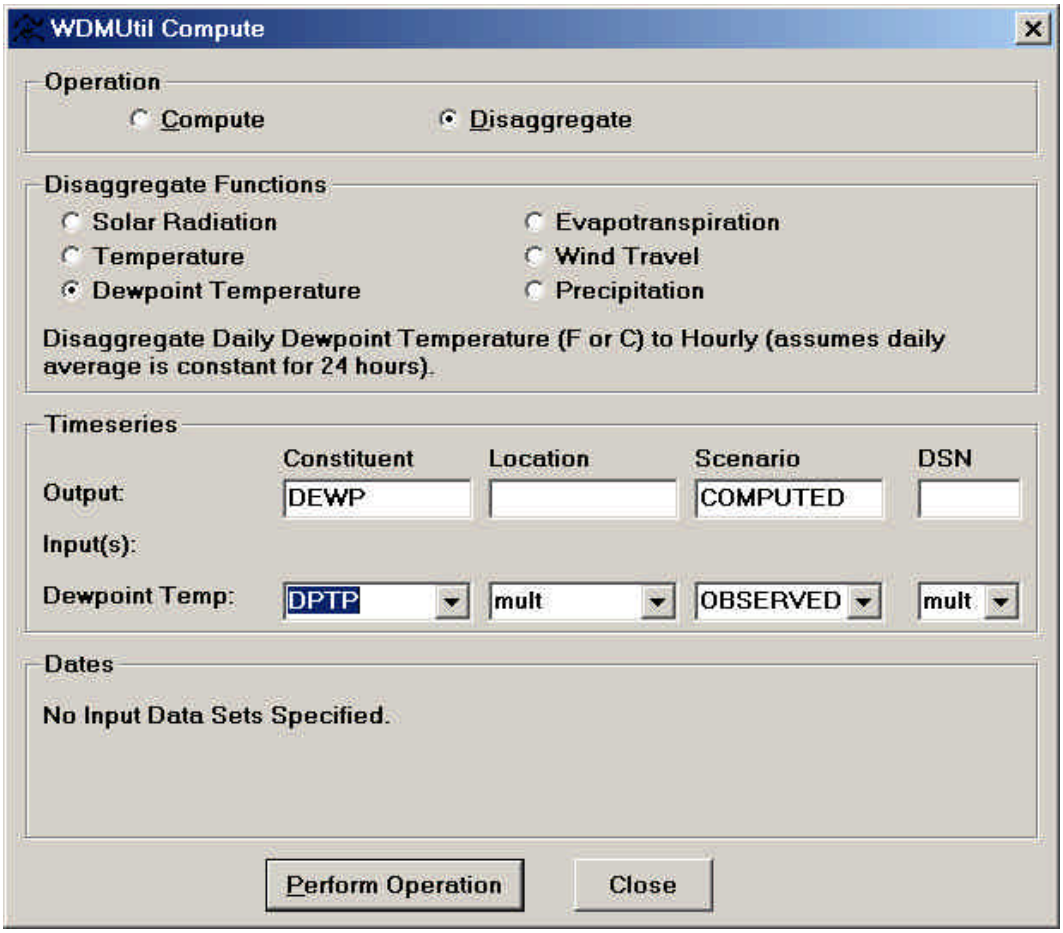
*Key steps to Disaggregate daily dewpoint temperature data to hourly dewpoint temperature data:*

1. Click on the **Compute** button in the Tools frame and the Compute form will be displayed.

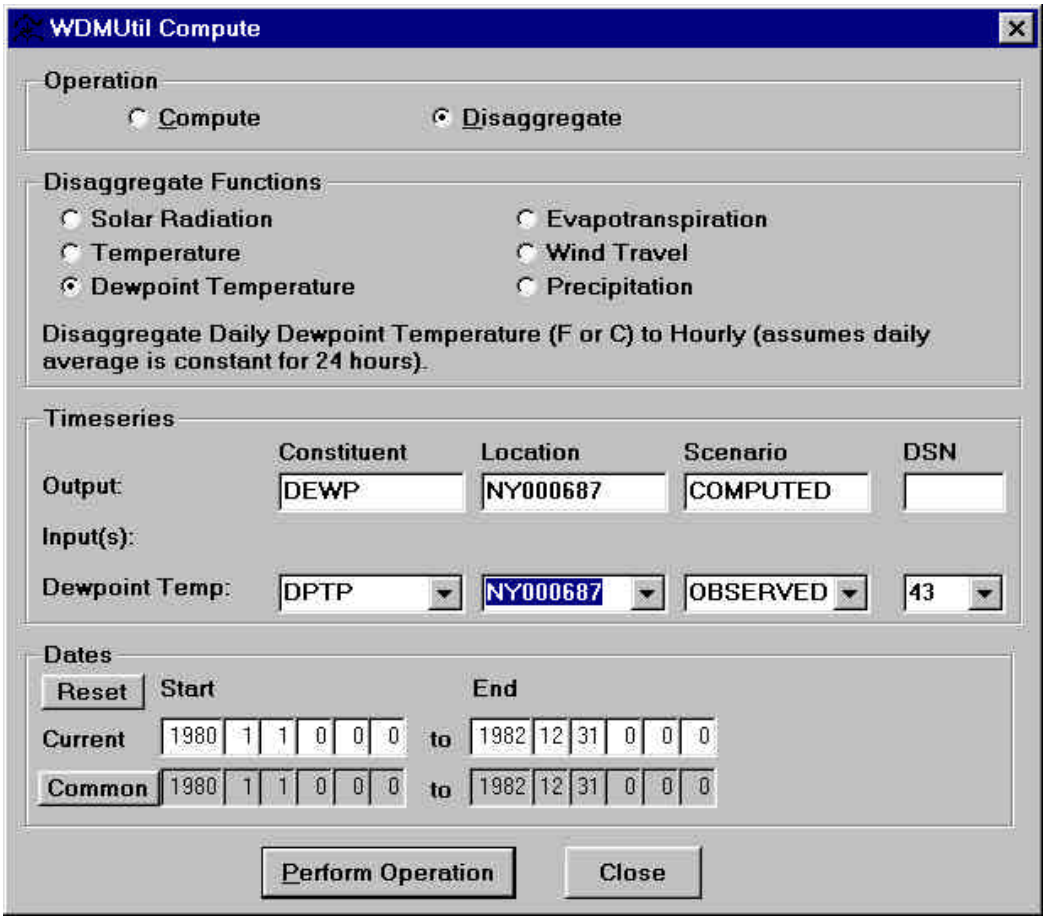


2. Select the *Disaggregate* option in the **Operation** frame.

3. Select the *Dewpoint Temperature* option in the **Disaggregate Functions** frame. The needed input and output time series are specified in the **Time Series** frame. The pull-down list next to the **Dewpoint Temperature** label contains all of the constituent types from the available time series. Since WDMUtil knows that daily *Dewpoint Temperature* data is needed to disaggregate to hourly dewpoint, it has defaulted the list to the *DPTP* (daily dewpoint temperature) item.

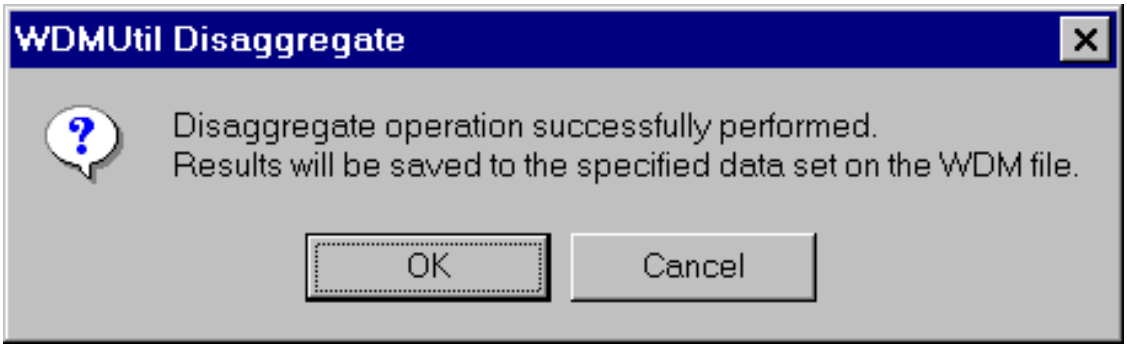



4. The **Locations** and **Scenarios** lists have now been updated to contain only items from time series that are of daily dewpoint temperature type. The *mult* displayed in the Location column indicates that there is more than one location that has daily dewpoint temperature data. Click on the **Locations** list and select the first item in the list *NY000687*.



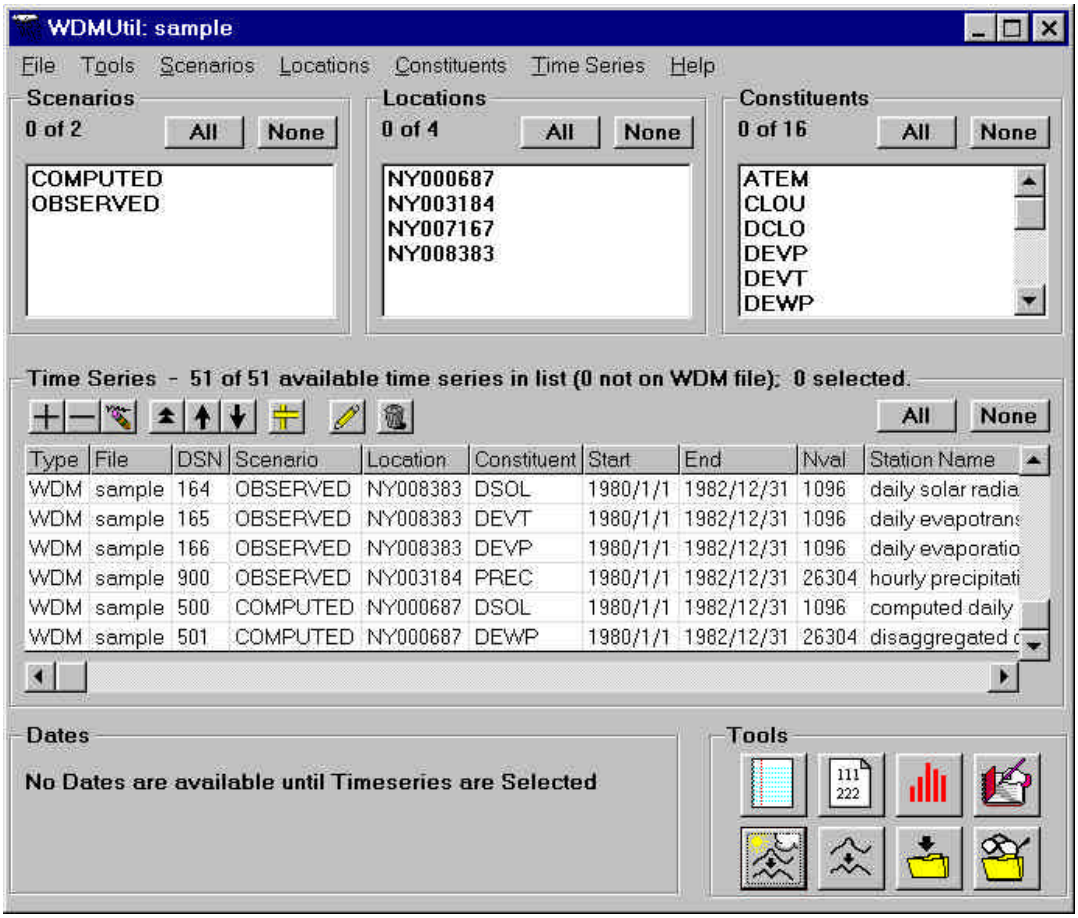

5. The *OBSERVED* displayed in the **Scenario** List indicates that this is the only scenario for which dewpoint temperature data at location *NY000687* exist. The 43 displayed in the **DSN** (data-set number) list indicates that a unique time series has been defined by the selections in the **Constituent**, **Location**, and **Scenario** lists. (If a user knows the number of the time series needed, they may select it from the DSN first and the Constituent, Location, and Scenario items will be filled in for that time series.) Note that default values for the output time series have been supplied as the input time series specifications were made. The only remaining item to be specified for the output time series is its number. Enter 501 in the text field for output DSN.

6. The start and end dates, displayed in the **Dates** frame, reflect the period of available data in the input time series. Leave the start and end dates as they are and now click the **Perform Operation** button. A message box will be displayed indicating that the operation was successful and asking to confirm that the disaggregated data should be stored on the designated output time series.


WDMUtil Disaggregate
Disaggregate operation successfully performed.
Results will be saved to the specified data set on the WDM file.
OK
Cancel

7. Click the OK button on the message box.
8. Click the OK button on the ensuing message box reporting that the data set was successfully stored on the WDM file.
9. Click the Close button on the Compute form.

Note that the main form has been updated to include the newly disaggregated time series.

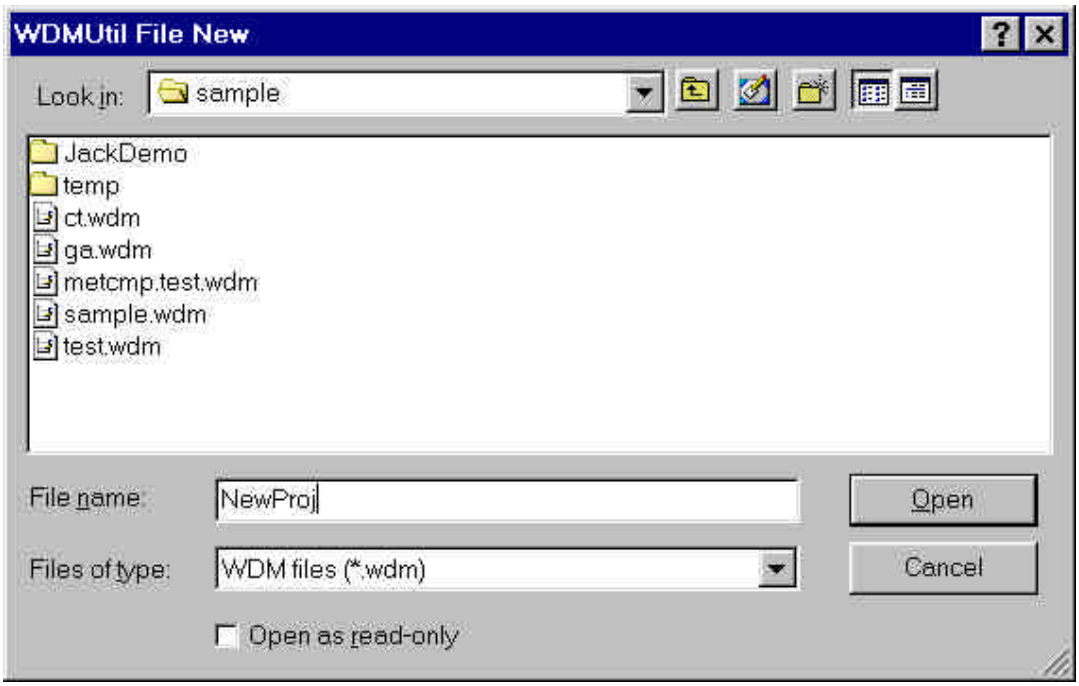



A second item (*COMPUTED*) has been added to the **Scenarios** list (if it wasn't there already) since the newly computed time series' scenario name was *COMPUTED*. Scrolling to the bottom of the list in the **Time Series** frame will display the new time series. From here, either proceed on to Lesson 8 or exit the program.

# Lesson 8: Creating a New WDM File

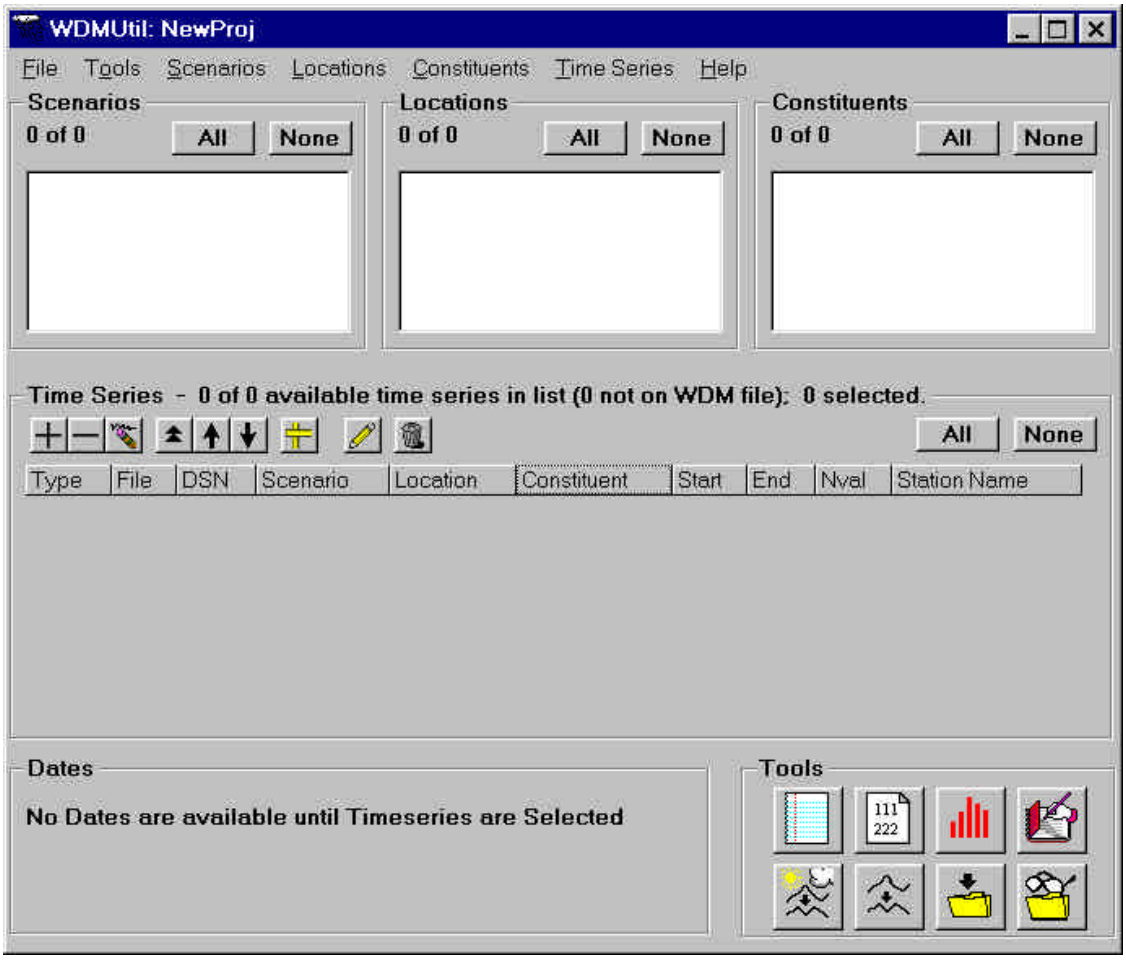
In this lesson, the method for creating a new WDM file will be demonstrated. Creating a new WDM file allows the user to build a WDM file that contains only the data they desire. The new WDM file is also likely to be much smaller than existing BASINS WDM files.

Begin by starting WDMUtil (or close the active file if currently running the program) and then selecting the *File:New* menu item. A file dialogue form is displayed for specifying the name of the new WDM file.




Enter *NewProj* in the text box for the name of the new WDM file. The file dialogue will automatically add a .wdm extension to the specified file name if the user does not provide it. Click the **Open** button to create the new WDM file.

Notice that the caption on the main form displays the base portion of the new WDM file's name. The various lists on the main form will be populated as data is read into the system and then added to the WDM file.




End the session by closing WDMUtil. You will notice the new WDM file residing in the directory in which it was created. You may delete this file after the session is concluded.

# Data Access and Selection

Data accessed by WDMUtil can be grouped into two general categories: WDM data and data in flat (ASCII text) files. WDMUtil requires a WDM file to be opened (or created) before any others. Once a WDM file is opened, other flat files containing data external to the WDM file may then be opened. All data access is initiated through the File menu. Existing WDM files are opened using the File:Open menu item and flat files are opened using the File:Import menu item. New WDM files may be created using the File:New menu item.

## File

When no WDM file is active, the available menu items under the File menu title are the New, Open, and Exit items.

After a WDM file is open, the available menu items are Import, Close, and Exit.

Once a WDM file is opened, it must be closed in order to open another WDM file or create a new WDM file.

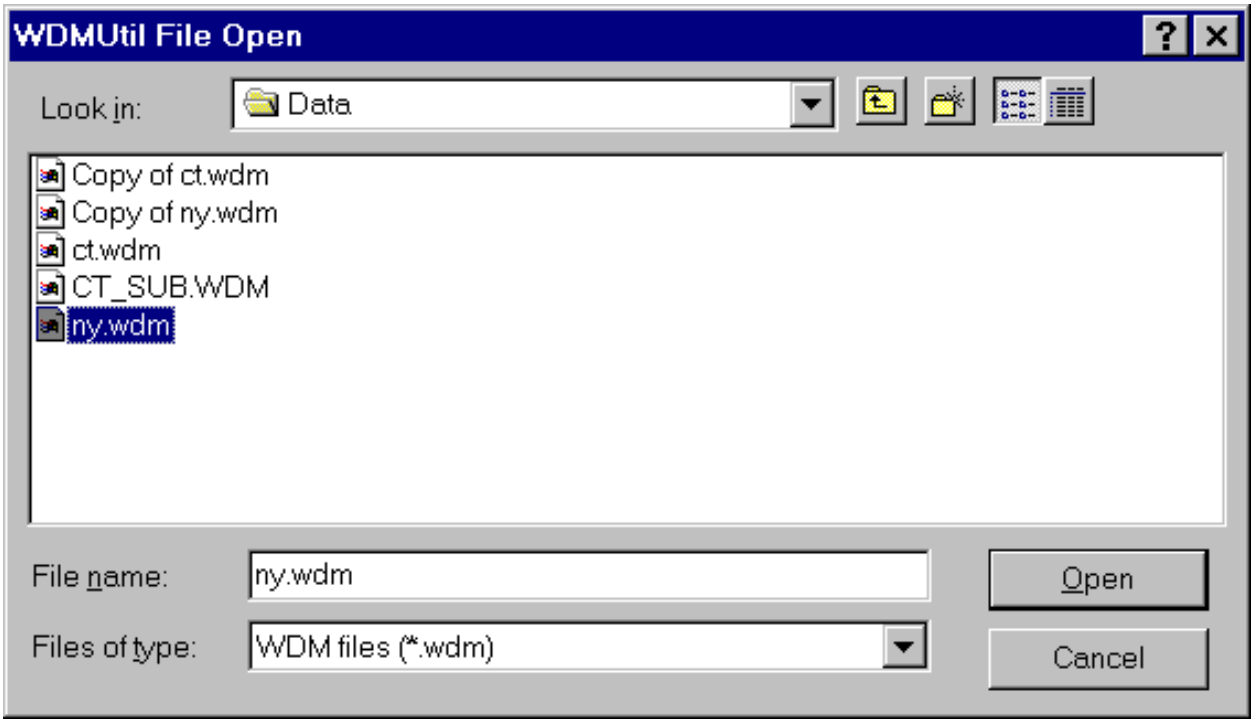
**New**

The *File:New* menu item is used to initiate the process of creating a new WDM file. Creating a new WDM file allows the user to build a WDM file that contains only the data they desire. The new WDM file is also likely to be much smaller than existing BASINS WDM files.

Selection of the *File:New* menu item causes a file open dialogue to appear which allows the user to enter a name for the new file. The file dialogue will automatically add a .wdm extension to the specified file name if the user does not provide it. If the file specified already exists, the user will be instructed to enter the name of a file that does not exist. After specifying the new WDM file name, the user will be asked to confirm that they want to create the file.

**Open**

Selection of the *File:Open* menu item causes a file open dialog box to be opened.




This dialog box is used to open the desired WDM file. Once the WDM file is opened, the WDMUtil main form will be refreshed based on the contents of the selected WDM file.

**Import**

Selection of the File:Import menu item allows the user to access time series data not on the WDM file and bring it into WDMUtil. From there the imported time series may be saved to the WDM file and/or analyzed and manipulated in the same manner as WDM time series.

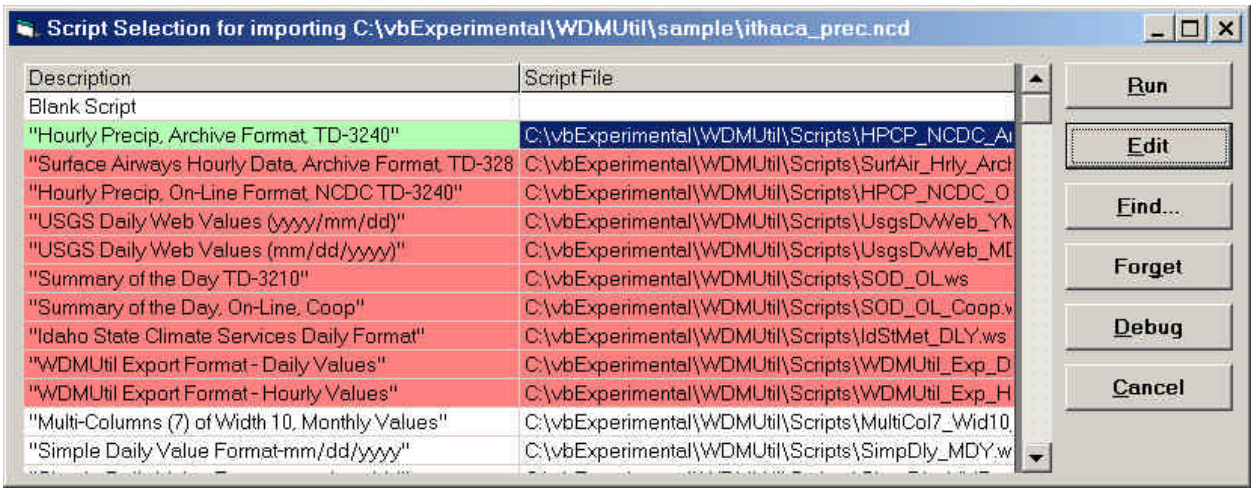
Importing of time series is performed using a scripting language. This language was developed to handle the wide variety of formats in which time series data are stored. Data import scripts have been developed to process most of the data formats found to date. However, the system is dynamic in that new scripts may be created and introduced into WDMUtil.

When the File:Import option is selected, a dialogue prompts the user for the name of the file containing the data to be imported. Once a file has been specified, the user has the option to select an existing script from the Script Selection form or to create a new script using the Script Creation Wizard. Alternatively, the user may also develop a new script by hand using a text editor and building a script from scratch or modifying an existing script. For other than simple formats, this method is preferred as the Script Creation Wizard may not be able to successfully create scripts for complex formats.

Details of the **Script Selection** and **Script Creation Wizard** forms are presented in the ensuing sections. Details on the scripting language are presented in the appendix section named Scripting Language.

**Script Selection**

Once a file has been selected for importing, the Script Selection form is displayed.




The form displays all of the data import scripts of which WDMUtil is aware. The list of scripts contains a column of short descriptions and a column of script file names. Green scripts have tested the current file and can probably read it. Pink scripts have tested the current file and probably can't read it. Red scripts contain errors or cannot be found on disk. Other scripts are unable to test files for readability.

If a script is green (or you are certain that the script will properly process the data), selecting it and then clicking the **Run** button will cause the data to be read and brought into WDMUtil.

If no appropriate script is available, the user has three options:

1. Selecting a script that processes data similar to yours and then clicking the **Edit** button to bring up the Script Creation Wizard. From there the script may be modified to process your data.

2. Selecting the *Blank Script* item and then clicking the **Edit** button to bring up the Script Creation Wizard. From there a new script may be built to process your data.

3. Using a text editor to modify an existing script to process your data.

**Note: some complex scripts use features that can not yet be edited in the graphical interface. These scripts may be edited manually as text files before pressing 'Run'.**

Clicking the **Find** button browses your disk for new scripts that are not in the list. The full suite of scripts distributed with WDMUtil may be found in the */scripts* directory under the directory where WDMUtil was installed.

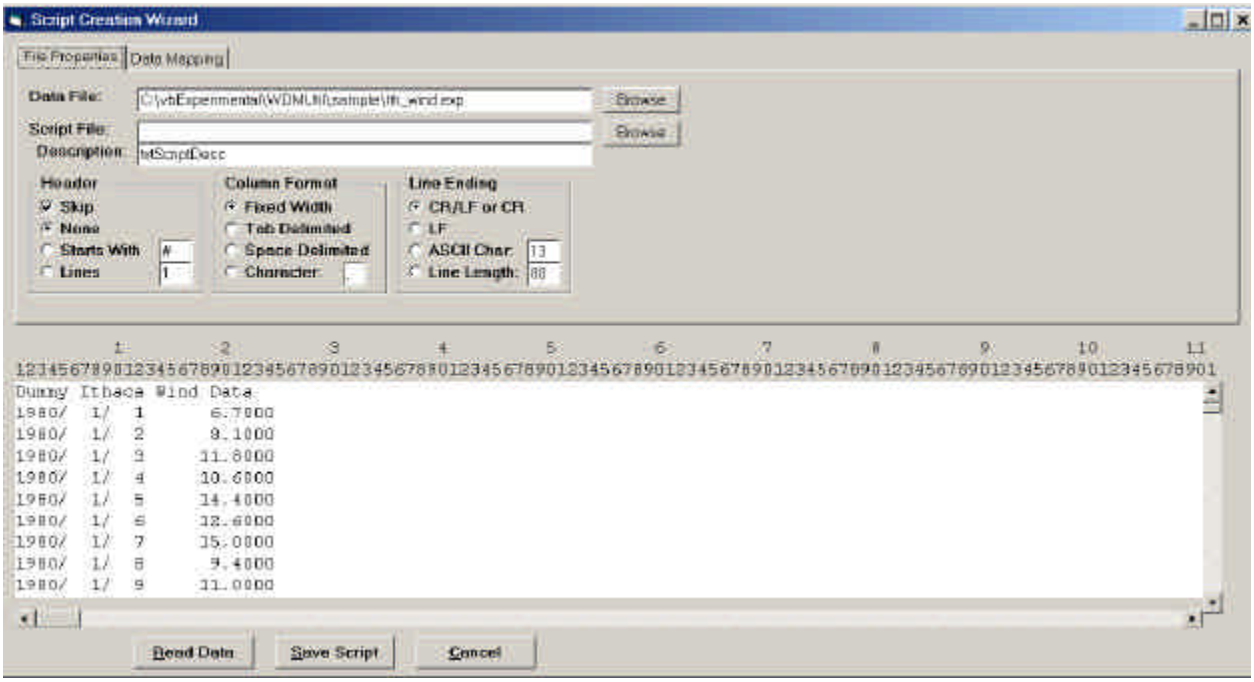
Clicking the **Forget** button removes the selected script from the list, but leaves it on disk.

Clicking the **Debug** button runs the selected script one step at a time. This is a useful tool when creating new scripts and you want to check each step of the script as it processes the data.

Clicking the **Cancel** button closes the **Script Selection** form without importing any data.

**Script Creation Wizard**

When the **Edit** button on the **Script Selection** form is clicked, the **Script Creation Wizard** is displayed.




The **File Properties** tab contains general specifications about the data file being imported. The name of the file being imported and the name of the script file being edited, along with its description, are displayed at the top of the form. (If building a new script, the Script File name will be blank). The Browse buttons to the right of the file names allow different files to be selected.

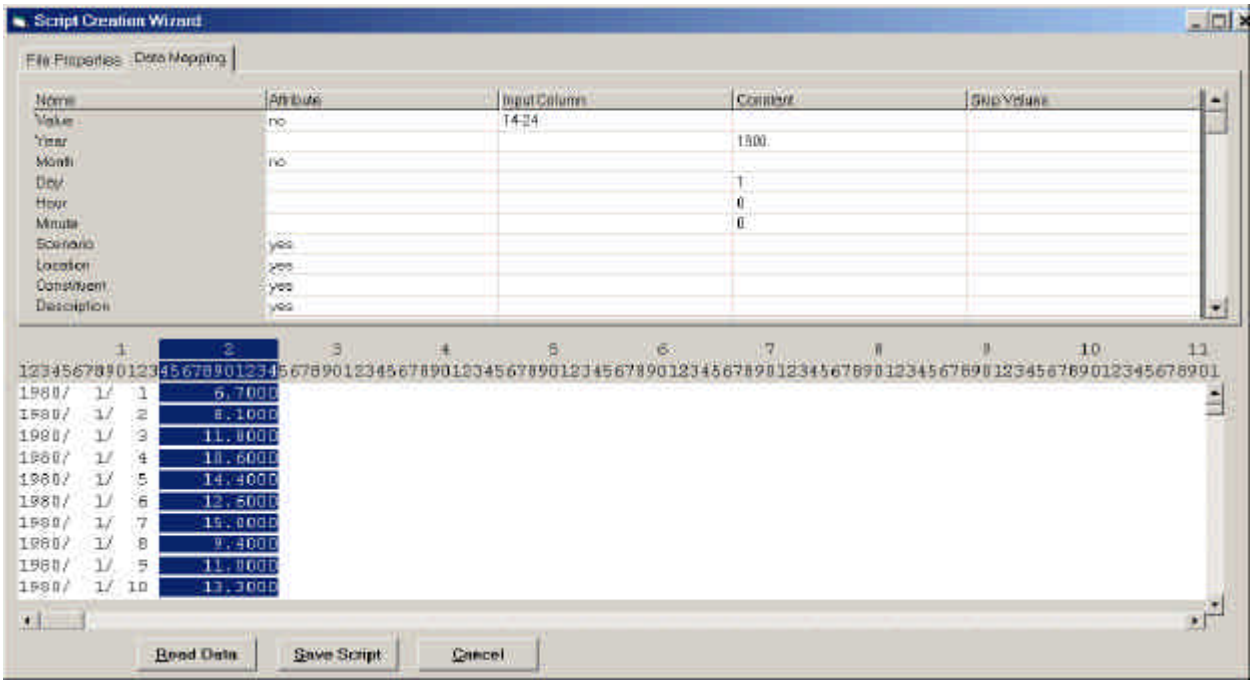
The **Header** frame contains specifications about processing any header lines in the file. If the **Skip** check box is checked, there are three options available for skipping header records: **None**, lines that **Start With** a specified character, or a specified number of **Lines**.

The **Column Format** frame contains specifications about the format of the data records. The **Fixed Width** option implies that the data elements (values, dates, etc) are in the same columns throughout the file. The **Tab** and **Space Delimited** options imply that the data elements are separated by tabs and spaces, respectively. The **Character** option allows the user to specify characters that separate the data elements.

The **Line Ending** frame contains specifications about what markers are used to indicate the end of the data records. The most common is **CR/LF** (carriage return/line feed), although some data downloaded from the internet may only contain a line feed (**LF**). Options for other **ASCII Char**acters or specific **Line Lenghth**s are also available.

As specifications are made in these frames, the display of the data file may be adjusted to reflect them. For example, if a specific number of header lines are identified to be skipped, that many header lines will be removed from the data file display.

After making the necessary **File Properties** specifications, the user will then click on the **Data Mapping** tab.




The list at the top of the **Data Mapping** tab contains *Name*s of various data elements used in importing data. The lower portion of the tab contains a display of the data file with column numbers across the top of it. These column numbers can be highlighted, by clicking and dragging with the mouse, to define the location of the data elements. Thus, to define the *Input Column* for a data element, click on that element and then click and drag on the column numbers in which the element is found. In some cases a data element's value will be constant (e.g. *Hour* and *Minute* for daily data). In such a case, the value for that element may be entered under the *Constant* column. The *Constant* column may also be used to apply a constant value to a data

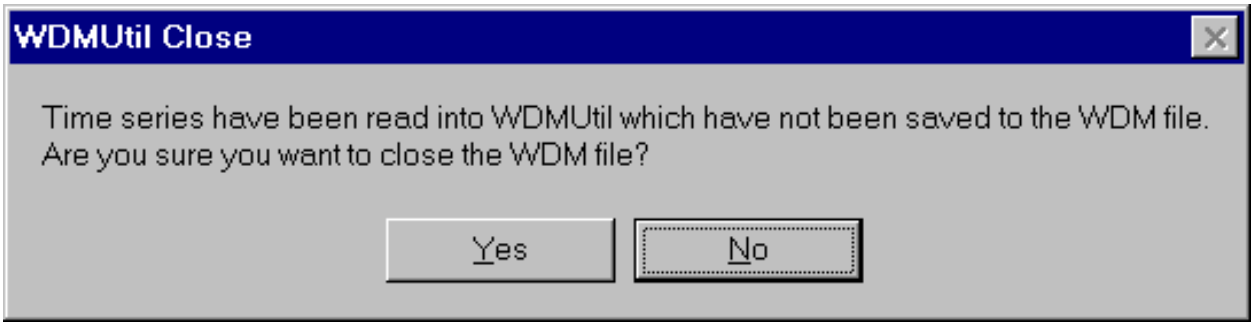
element. This is done by inserting the desired mathematical symbol in front of the constant value. For example, if the year values on a file were only the last two digits, entering *+1900* in the *Constant* column would add 1900 to the 2-digit year values when processing the data.

Some data elements are general information about the data being processed. These elements may be stored as attributes of the time series. To indicate a data element as an attribute, a *yes* is entered under the *Attribute* column for that element. The values for these attributes may then be entered under the *Constant* column. It is important to enter values for the *Scenario*, *Location*, and *Constituent* attributes as this will make the new time series more recognizable by WDMUtil and other BASINS components.

Once the data elements have been defined as desired, the **Save Script** button may be used to write the script to a file for future use. The **Read Data** button is used to try to process the data using the script defined in the wizard. The **Cancel** button will close the Wizard and no data will be imported.

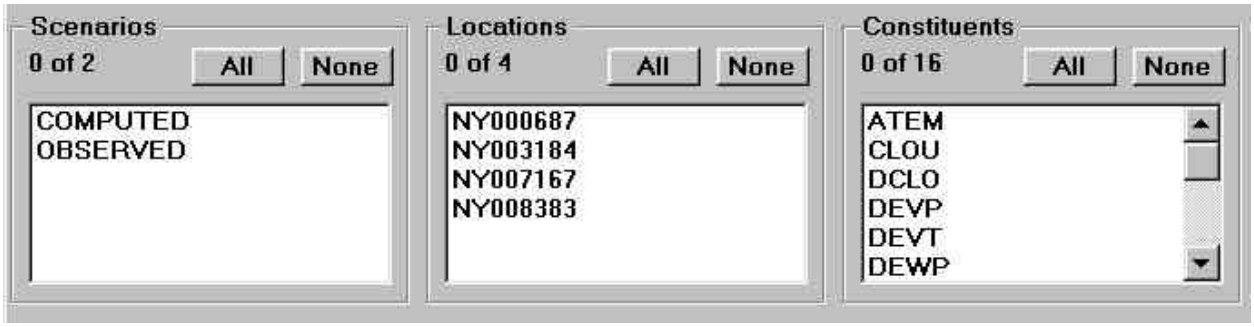
**Close/Exit**

The *File:Close* and *File:Exit* menu items close the currently active WDM file. The *File:Exit* item additionally shuts down the WDMUtil system. During the WDM file closing, WDMUtil checks to see if there was data read in that has not been saved to the WDM file. If there is, the user is asked whether or not they want to close or exit without saving the data.


WDMUtil Close
Time series have been read into WDMUtil which have not been saved to the WDM file.
Are you sure you want to close the WDM file?
Yes
No

Clicking the No button will return the user to the main form so that they may Write the data to the WDM file. Clicking the Yes button will close the WDM file without saving the data. If the *File:Exit* menu item was selected, WDMUtil will be shut down.

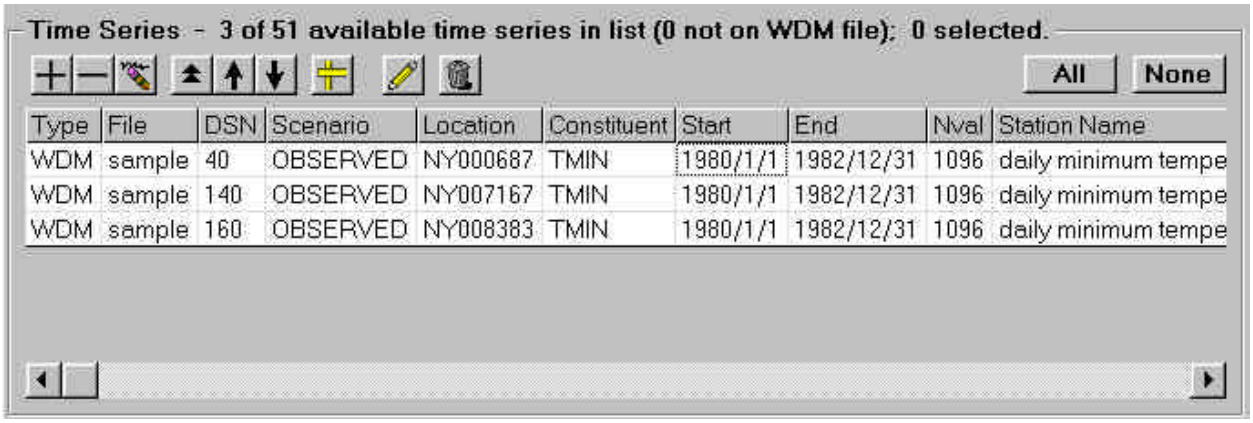
## Scenario, Location, Constituent Lists




The **Scenarios**, **Locations**, and **Constituents** frames of the main WDMUtil form display available and selected items associated with the time series that are known to WDMUtil. The summary label in the upper left corner of the frames shows a count of the items that are selected and available. The All button is used to select all available items. The None button deselects all items. The list of available items is in alphabetical order with selected items highlighted.

# Time Series

The **Time Series** frame of the WDMUtil form displays a list of the time series selected for analysis.


Time Series - 3 of 51 available time series in list (0 not on WDM file); 0 selected.
All
None
Type File DSN Scenario Location Constituent Start End Nval Station Name
WDM sample 40 OBSERVED NY000687 TMIN 1980/1/1 1982/12/31 1096 daily minimum tempe
WDM sample 140 OBSERVED NY007167 TMIN 1980/1/1 1982/12/31 1096 daily minimum tempe
WDM sample 160 OBSERVED NY008383 TMIN 1980/1/1 1982/12/31 1096 daily minimum tempe

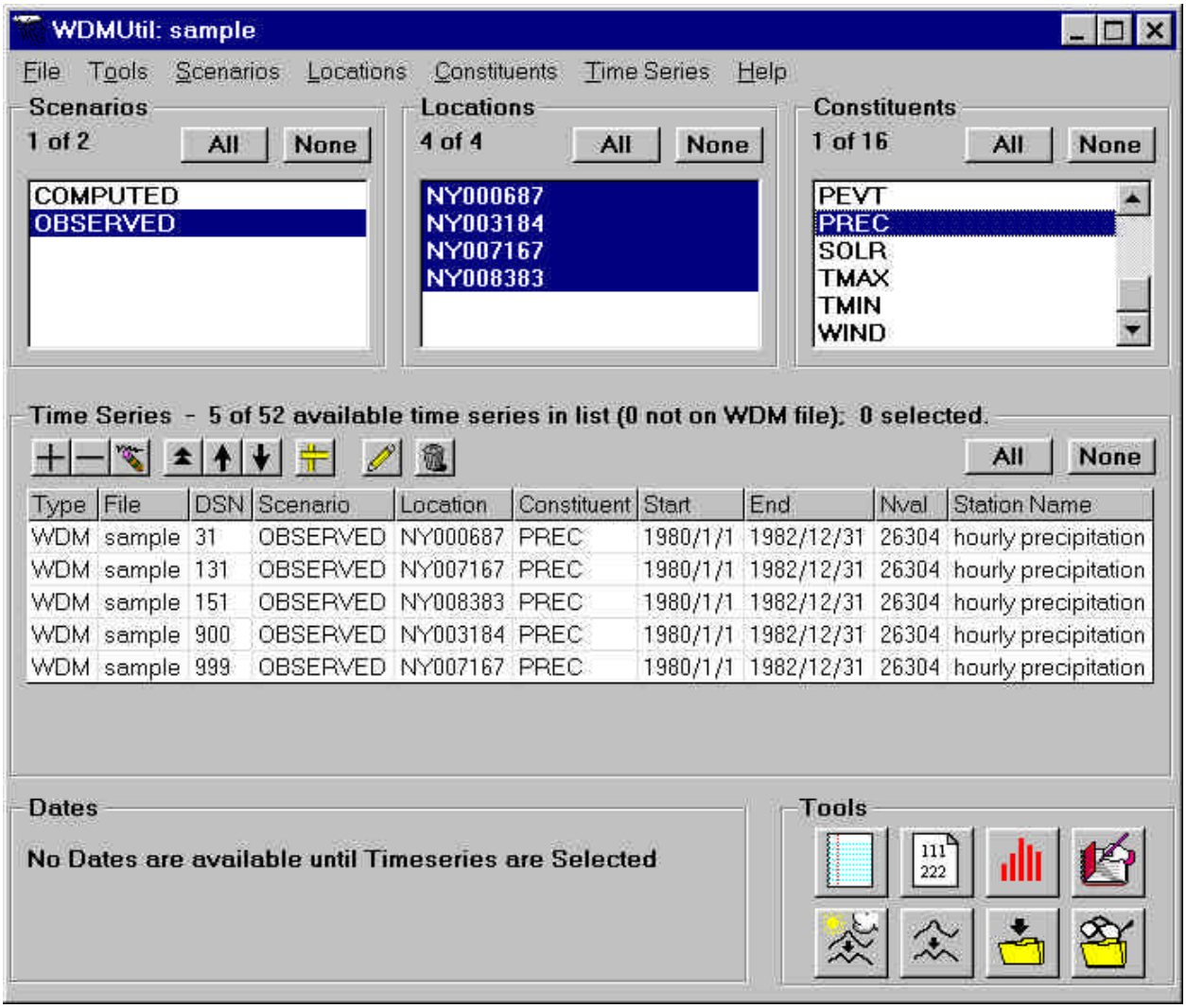
For any time series to be available to WDMUtil, three attributes must be present - constituent, location, and scenario. A toolbar and a corresponding menu title are provided to allow the user to manipulate the time-series list in a variety of ways. In the top left corner of the frame, the number of time series in the list is displayed along with the number of time series available in this project.

Each row in the list contains the attributes of one time series. To select a single time series, click on the corresponding row. There are two ways to select multiple successive time series in succession. The first step for both is to select the row representing the first time series. The next step is to either: 1) continue to hold down the left mouse button from the first selection and drag the mouse arrow to the row representing the last time series, or 2) hold down the Shift key and select the row representing the last time series. Multiple time series out of succession can be selected by holding down the Ctrl key while making the selections. To select all rows, click the All button in the top right corner of the frame. To deselect all rows, click the None button.

If there are any time series in the list, fields displaying the available dates will automatically appear in the Dates frame below the **Time Series** frame. Initially, the **Dates** frame includes the starting and ending dates of the period common to all time series in the list. If the **Common** button is clicked, then the union of the starting and ending dates for all time series in the list are displayed.

### Add Time Series

The **Add** button in the **Time Series** frame is used to add items to the time-series list. Available time series that meet the selected scenario, constituent, and location selections will be added. For example, if the user has selected *OBSERVED* from the **Scenarios** list, *PREC* from the **Constituents** list, and *All* from the **Locations** list, all *OBSERVED* time series with precipitation data will be added.




If no items are selected in either the **Scenarios**, **Locations**, or **Constituents** frame when the user clicks the **Add** button, then all items in that frame are considered for addition to the time-series list (i.e., having no items selected from one of these frames is the same as having all items selected). For Example, if the user has selected *OBSERVED* from the **Scenarios** list, *PREC* from the **Constituents** list, and has made no selections from the **Locations** list, then the same time series as shown above will be added to the list.

**Remove Time Series** 

The **Remove**  button in the **Time Series** frame is used to remove items from the time-series list. The text in the left-most column of the list must be selected for that item to be removed. For example, to remove *OBSERVED PREC* at *NY000687*, click on the text *WDM* in the left-most column for that list item to select it, and then click on the **Remove** button. Multiple time series can be removed at once by highlighting several list items and then clicking on the **Remove** button.

**Clear Time Series List**

The **Clear** button in the **Time Series** frame is another way to remove items from the time-series list. This button removes all time series from the list if none are selected. If one or more time series are selected, this button removes the selected time series plus all of the time series below it on the list.

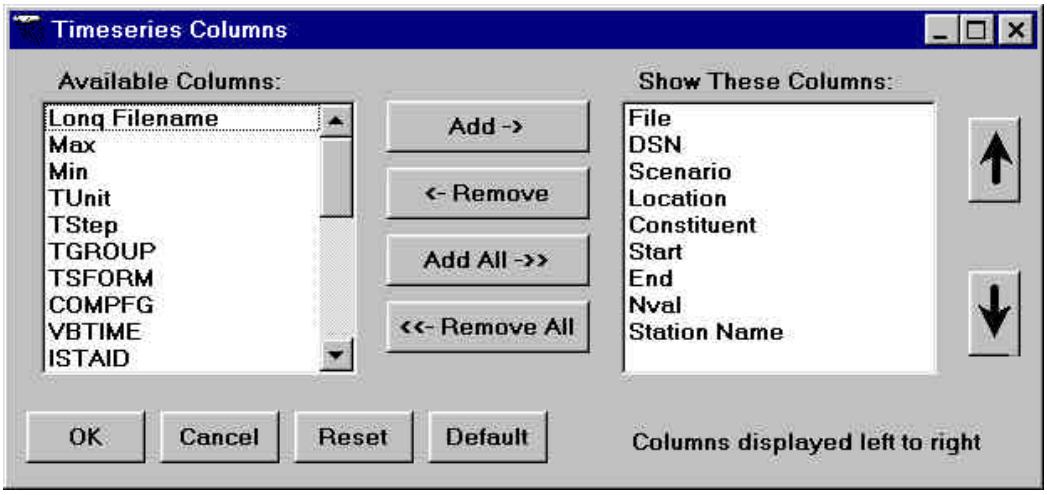
**Move Time Series Up and Down**

The **Move** buttons in the **Time Series** frame are used to move items in the time-series list up or down in the list. The order of the time series in the list is of particular importance for the Duration and Compare analyses.

These buttons require one item in the time-series list to be selected. A list item may be selected by clicking on the text for that item in the left-most column. Clicking on the arrow pointing up will move that item up one place in the list, while clicking on the arrow pointing down will move that item down one place in the list. Clicking on the first double arrow moves a selected time series to the top of the list.

**Columns**

The **Columns** button in the **Time Series** frame is used to specify which attributes of items in the time-series list will be displayed as columns in the grid. Clicking on this button produces a Time-Series Columns form that may be used to manage the columns of the list. The form contains an **Available Columns** and **Show These Columns** list. Individual items are moved from one list to the other by selecting a list item and then clicking on the **Add** button or **Remove** button. All items can be added to or removed from the **Show These Columns** list by clicking on the **Add All** or **Remove All** buttons, respectively. There are nine default attributes: **Type** - file type as indicated by file name extension **File** - file name without path or extension **DSN** - data set number **Scenario** - selected item from **Scenarios** frame **Location** - selected item from **Locations** frame **Constituent** - item selected from **Constituents** frame **Start** - beginning date of time series **End** - ending date of time series **Nval** - number of data values in time series **Station Name** - name of the U.S.G.S. meteorological station




When an item in the **Show the Following Columns** list is selected, the **Move Up** button and **Move Down** button can be used to move the column relative to the other columns of the time-series list. The **Reset** button returns the selected columns and the order of these columns to their original state when the form was invoked. The **Default** button returns the columns to their default positions. The **OK** button removes this form while applying these changes to the time-series list, while the **Cancel** button removes this form without applying these changes to the time-series list.

### Save List

The **Save List** item in the **Time Series** frame on the main menu is used to save the items in the time-series list to a buffer file for later use. Selecting this menu option invokes the file save common dialog, from which a user may specify the file name to which this list is to be saved.

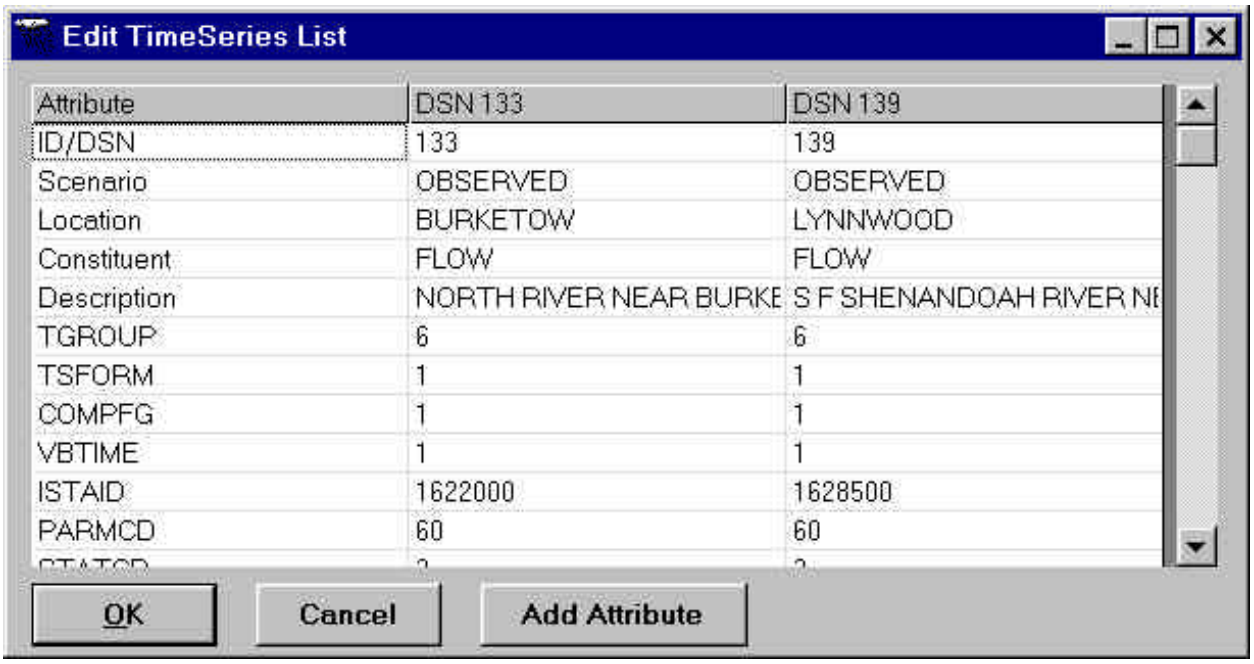
### Get Buffer

The **Get List** item in the **Time Series** frame on the main menu is used to retrieve items in the time-series list from a file. Clicking on this button invokes a common dialog that is used to specify the file name from which this list will be opened.

This feature is designed so that a user might retrieve a list of items for the time-series list saved previously to a file. The scenario, location, and constituent specifications are read from the file; and if a time series is available with those attribute values, it will be added to the time-series list.

### Edit Time Series Attributes

The **Edit** button in the **Time Series** frame is used to edit the attributes of items in the time-series list. One or more list items must be selected before clicking on this button.



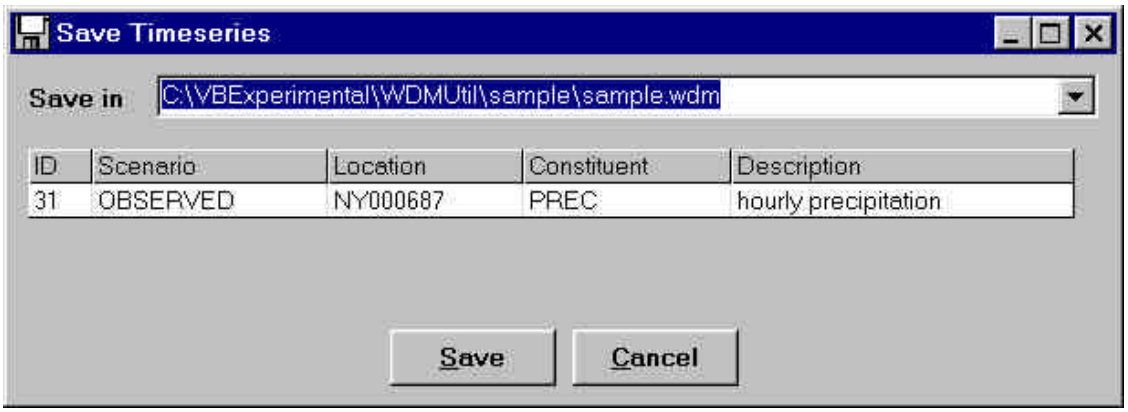

The **Edit Time-Series List** form lists the attributes of each selected data series number (DSN). The **Add Attribute** button creates an empty row at the bottom of the table. Double-clicking the **Attribute** field in this row displays a list box with the attributes that may be added to the DSN. The OK button removes this form while applying these changes to the time series, while the Cancel button removes this form without applying these changes to the time series.

**Delete Time Series**

The **Delete** button in the **Time Series** frame is used to delete time series. One or more time series in the time-series list must be selected before clicking on this button. Deleted time series on the WDM file will be removed from the WDM file (a message box will ask the user to confirm this action). Deleted time series that are *In-Memory* will no longer be available in WDMUtil.

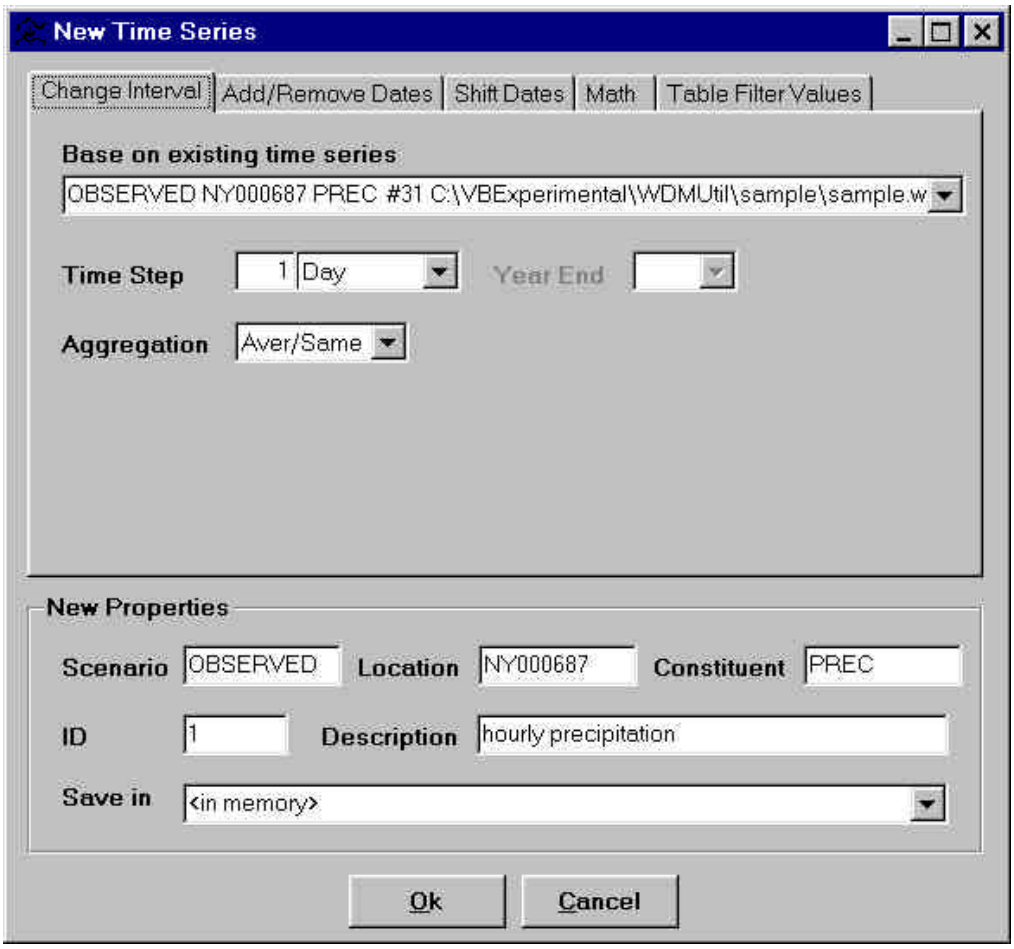
**Save Time Series**

One or more time series listed in the grid on the main form can be saved in memory or to file by choosing the Save Time Series item under Time Series on the main menu. The list box at the top of the **Save Time Series** form allows the user to select where the time series will be stored. The grid on the form lists all the time series to be saved. Press the Save button to complete the operation or the Cancel button to return to the main form without saving.



### New Time Series

The user can create a new time series by choosing the New Time Series item under Time Series on the main menu. This function can also be accessed by clicking the **Generate Time Series** button on the Analysis toolbar. Either method invokes the **New Time Series** form shown below.




The properties of the new time series are specified in the **New Properties** frame at the bottom of the tab. The **Scenario**, **Location**, **Constituent**, and **Description** fields default to the corresponding properties of the selected time series. If no time series is selected, these fields are blank. The user may edit any of these fields. The **ID** field assigns a unique numeric identification to the time series; therefore, ID values for existing time series in the active project can not be reused. The ID is equivalent to the Data Set Number (DSN) of a time series stored in a .wdm file. The **Save In** list box allows the user to choose whether the new time series will be stored temporarily in memory or permanently to a WDM file.

There are five general processes by which the user may create a new timeseries, and each process has its own tab at the top of the form.

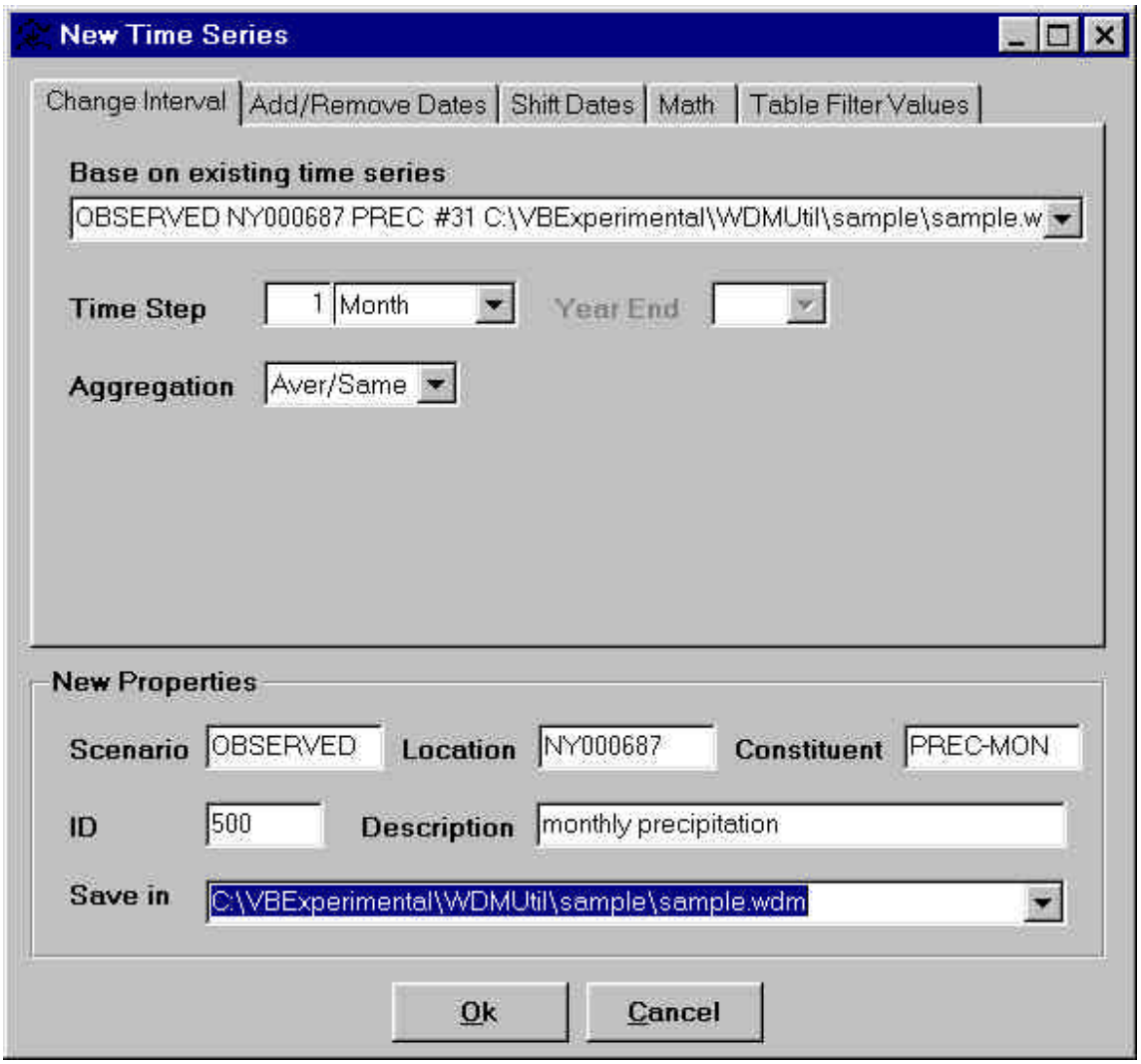
| Tab | Description |
|---|---|
| Change Interval | Changes the time step interval (i.e., day to month) for a time series listed in the **Time Series** frame of the main form. |
| Add/Remove Dates | Modifies time span and/or time interval of existing time series, or Creates completely new time series with specified time span and interval. |
| Shift Dates | Transposes time series forward or backward in time. |
| Math | Performs mathematical operations on select arguments, which can be either manually entered or chosen from existing time series. |
| Table Filter Values | Modifies values in an existing time series that are within a specified range. |

**Change Interval**

In order to change the time-step interval for an existing timeseries, click on the Change Interval tab on the New Time Series form. The existing time series is selected from the list box at the top of this tab. The new time-step interval is specified in the Time Step fields. The Aggregation field determines how values are assigned to the new time series. The values assigned by each aggregation option depend on whether the new time step has the same, a lower, or a higher frequency than the native time step.

| Aggregation Option | New Time Step Is More Frequent | New Time Step Is Less Frequent |
|---|---|---|
| Aver/Same | existing or nearest existing values assigned to the new time series | the average of existing values in that time interval are assigned to the new time series |
| Sum/Div | nearest existing values are scaled down by appropriate factor to yield same total value over period of existing time step | existing values are summed over period of new time step |
| Max | Nearest existing value is assigned to new time series | Maximum existing value within corresponding period of existing time step is assigned to new time series |
| Min | Nearest existing value is assigned to new time series | Minimum existing value within corresponding period of existing time step is assigned to new time series |

Edit the New Properties frame then click the Ok button to add a new time series to the Time Series list on the main form. Click the Cancel button to return to the main form without completing the operation.


New Time Series
Change Interval
Add/Remove Dates
Shift Dates
Math
Table Filter Values
Base on existing time series
OBSERVED NY000687 PREC #31 C:\VBExperimental\WDMUtil\sample\sample.w
Time Step
1
Month
Year End
Aggregation
Aver/Same
New Properties
Scenario
OBSERVED
Location
NY000687
Constituent
PREC-MON
ID
500
Description
monthly precipitation
Save in
C:\VBExperimental\WDMUtil\sample\sample.wdm
Ok
Cancel

**Add or Remove Dates**

The Add/Remove Dates tab on the New Time Series form allows the user to create a new time series with a constant time-step interval over a specific time span. The new time series can either be based on an existing time series or created entirely from scratch. This determination is made by selecting one of the two radio buttons at the top of the form.

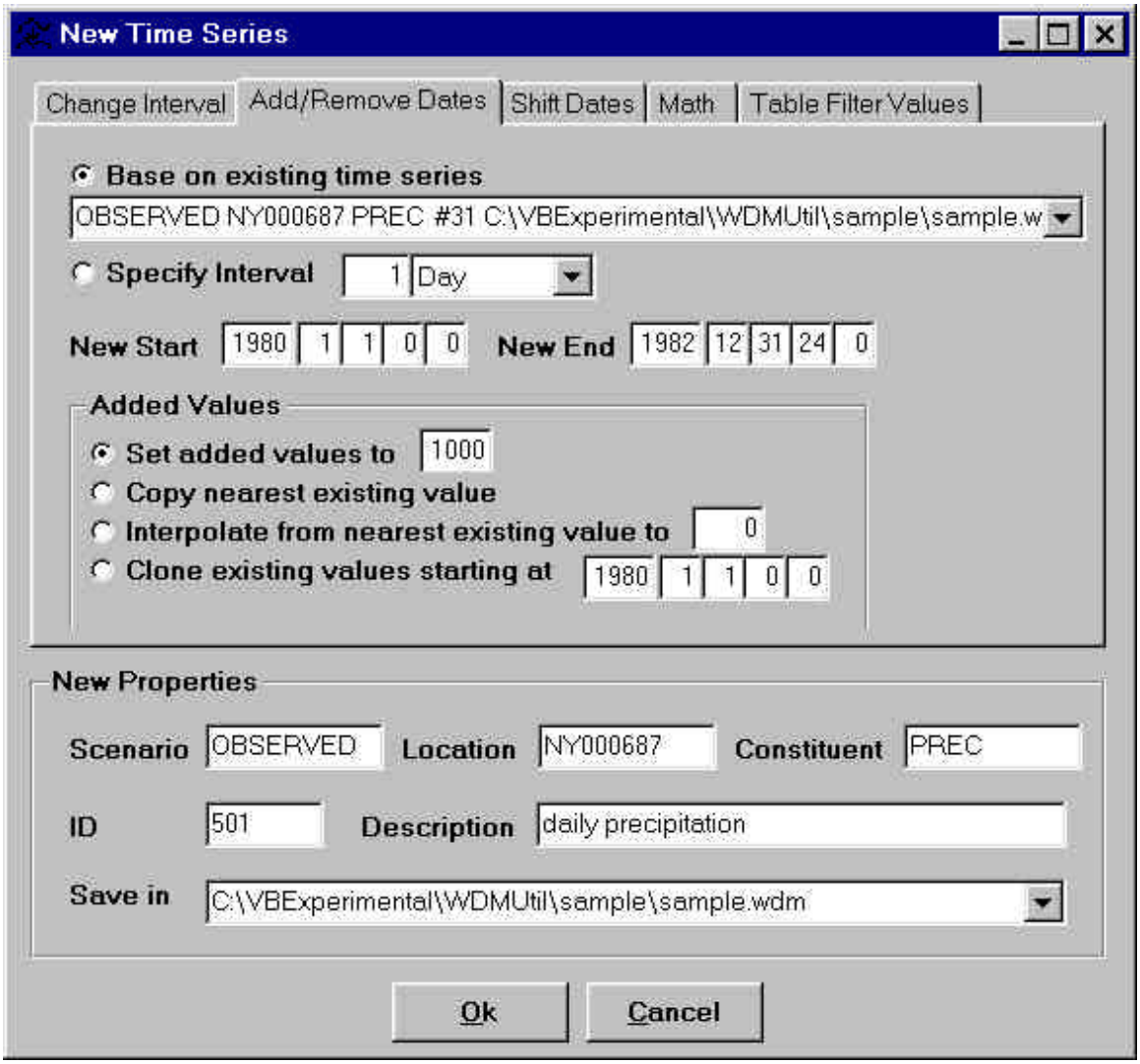
When the **Base on existing time series** radio button is selected, the baseline time series is selected from the list box underneath that radio button. The interval of the new time series is the same as the existing time series. The **New Start** and **New End** date frames determine the period of the new time series.

When the **Specify Interval** radio button is selected, the desired interval is set in the fields to the right of that radio button. There is no need to have a time series selected for this option. Again, the **New Start** and **New End** date frames will determine the period of the new time series.

The four options for inputting values into the new time series are contained in the **Added Values** frame. If **Specify Interval** has been selected, only the **Set added values to** option is available.

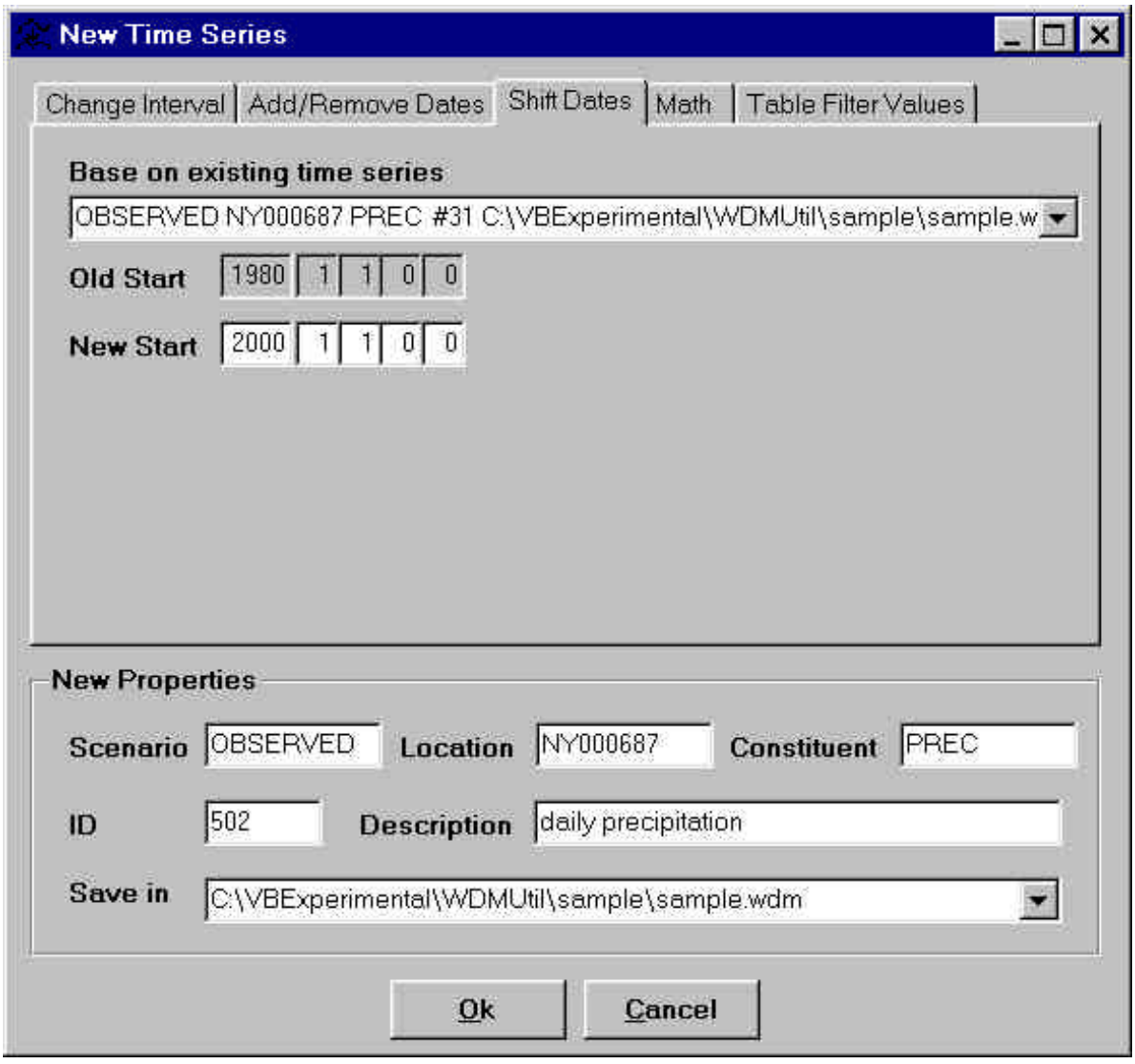
| | |
|---|---|
| **Set added values to** | Sets all new time series data to this user-entered value. |
| **Copy nearest existing value** | Sets new time series data to the nearest chronological value in the existing time series |
| **Interpolate from nearest value to** | Sets new time series data by interpolating between the nearest chronological value in the existing time series and the user-entered value. |
| **Clone existing values starting at** | Sets new time series data by transposing values in time from the existing time series, beginning at the user-specified date, to the period of the new time series. |

Edit the New Properties frame then click the Ok button to add the new time series to the list on the main form. Click the Cancel button to return to the main form without completing the operation.


New Time Series
Change Interval
Add/Remove Dates
Shift Dates
Math
Table Filter Values
Base on existing time series
OBSERVED NY000687 PREC #31 C:\VBExperimental\WDMUtil\sample\sample.w
Specify Interval
1
Day
New Start
1980 1 1 0 0
New End
1982 12 31 24 0
Added Values
Set added values to
1000
Copy nearest existing value
Interpolate from nearest existing value to
0
Clone existing values starting at
1980 1 1 0 0
New Properties
Scenario
OBSERVED
Location
NY000687
Constituent
PREC
ID
501
Description
daily precipitation
Save in
C:\VBExperimental\WDMUtil\sample\sample.wdm
Ok
Cancel

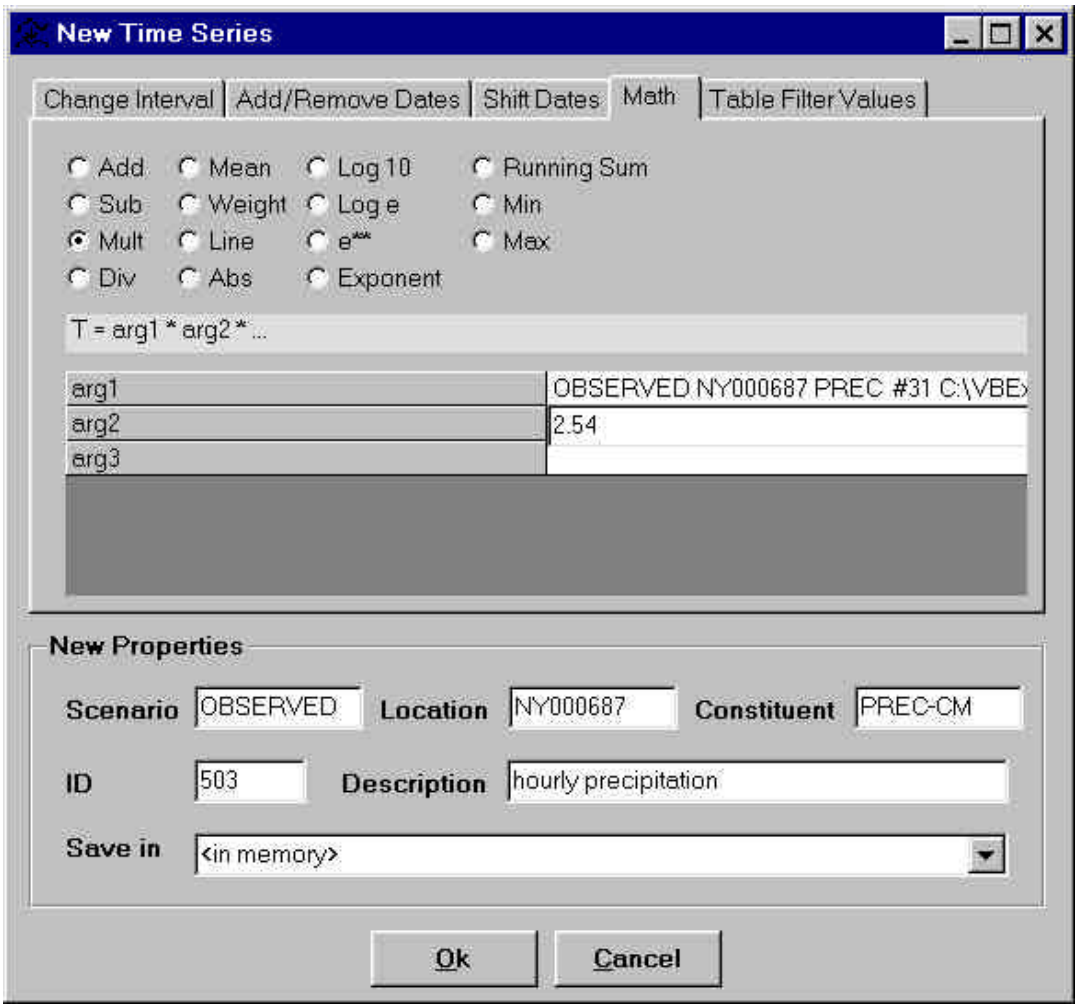
**Shift Dates**

In order to shift the starting and ending date of an existing time series backward or forward in time, select the Shift Dates tab on the New Time Series form. Choose the existing time series from the list box at the top of the form then type in the desired New Start date. Edit the New Properties frame then click the Ok button to add the new time series to the list on the main form. The Dates frame may need to be updated by the user to include the range of the new time series.



## Math

In order to use a mathematical operation to convert data in an existing time series, select the Math tab on the New Time Series form. Click the radio button of choice from the list of radio buttons at the top of the form. The resulting computation is summarized in the light gray label beneath the radio buttons. The actual arguments for the computation are specified in the list at the bottom of the tab. Double-click the fields next to the *arg1*, *arg2*, etc... Existing time series can be selected as arguments or the user can type in a numeric value.




The final mathematical option in the list of radio buttons is Interpolate. The arguments for this option have special meanings. At least on time series must be selected as an argument. The interpolate function looks for missing values in this time series and replaces them by interpolating between the chronologically nearest values. Numerical arguments are used to signal missing values in the time series (i.e., a common value for missing data in a time series is -999 so that value would be entered as an argument). If more than one time series is selected, the

period of the new time series is set equal to the union of the periods of all the time series excluding the first.

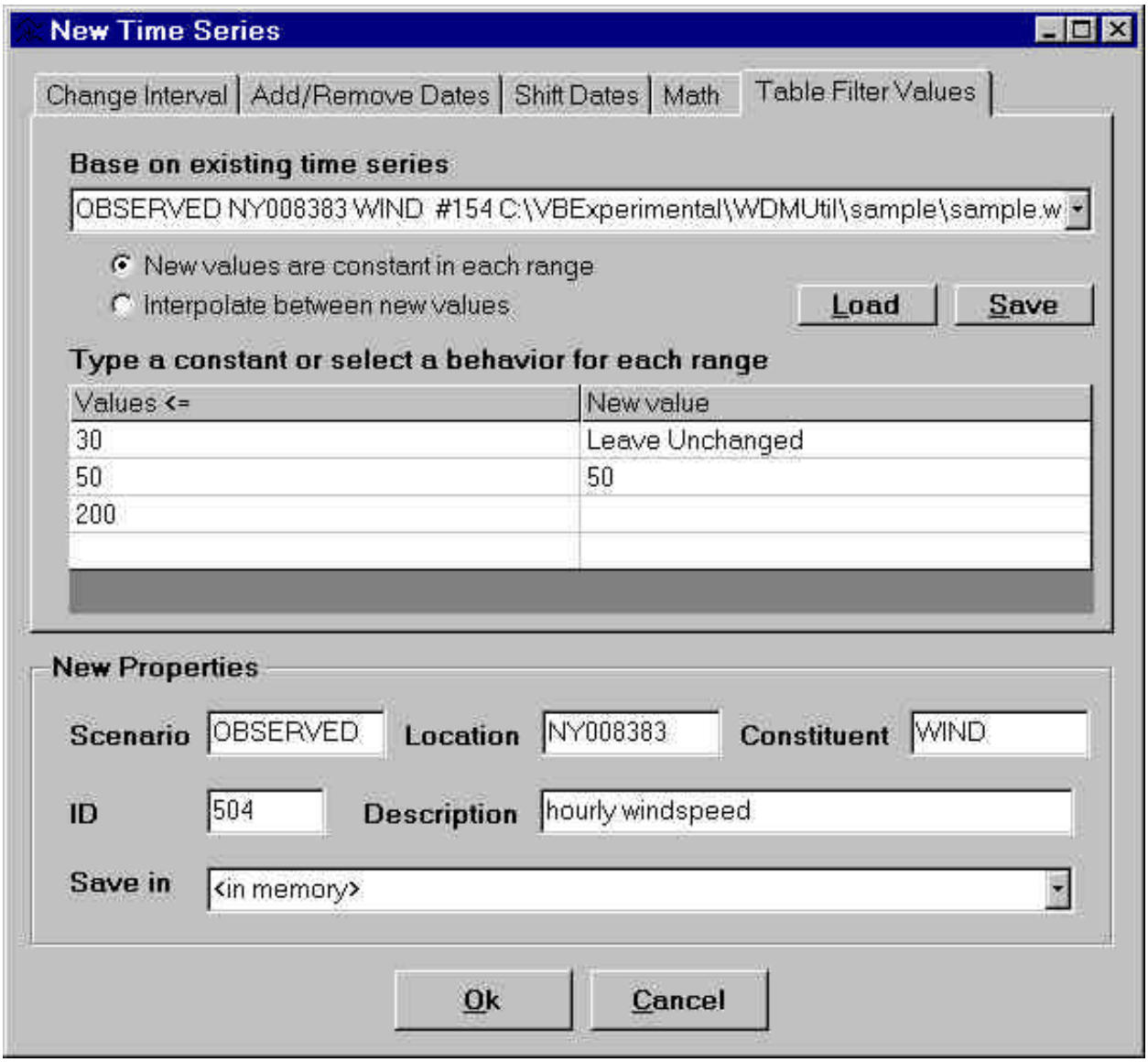
Edit the New Properties frame then click the Ok button to add the new time series to the list on the main form. Click the Cancel button to return to the main form without completing the operation.

**Table Filter Values**

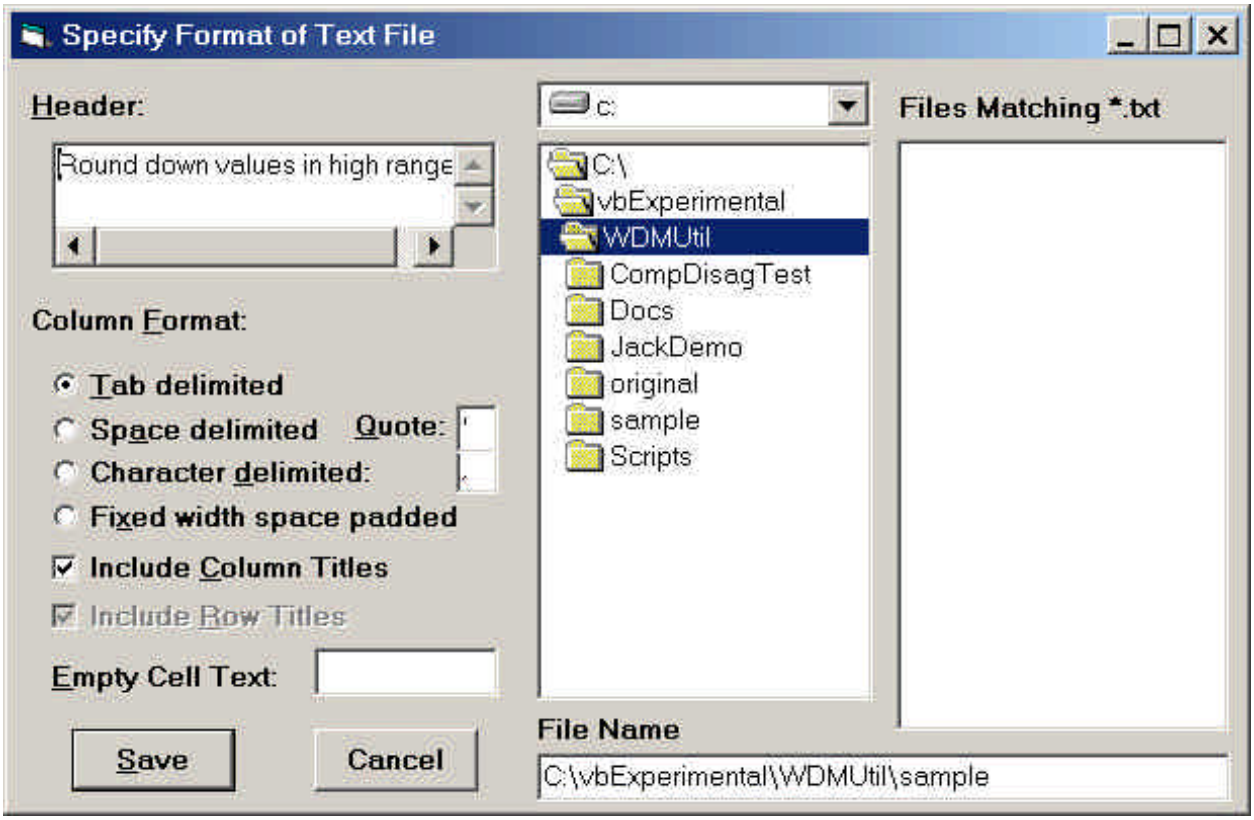
In order to reassign values within defined numeric ranges of an existing time series, select the Table Filter Values tab. Choose the existing time series from the list box at the top of the form. Values are reassigned by one of two methods:

- The **New values are constant in each range** radio button reassigns values within a defined range to a single value
- The **Interpolate between new values** radio button reassigns values by interpolating between two values that represent contiguous ranges

Values are entered in the *Values* <= column of the grid on this tab by clicking a cell then typing in a value. Values are entered in the *New value* column by double-clicking a cell then: 1) selecting either the *Delete* or *Leave Unchanged* list item, or 2) typing in a value. The most orderly way to complete the grid is to begin with the lowest range at the top of the form and add each successively higher range on the ensuing line. For the grid shown in the picture below, all values <=5000 are left unchanged and all values up to 999,999 are rounded down to 5,000. Edit the New Properties frame then click the Ok button to add the new time series to the list on the main form. Click the Cancel button to return to the main form without completing the operation.




The **Save** button causes the following form to appear, which is used to save to file a set of specifications for the Table Filter Values tab.



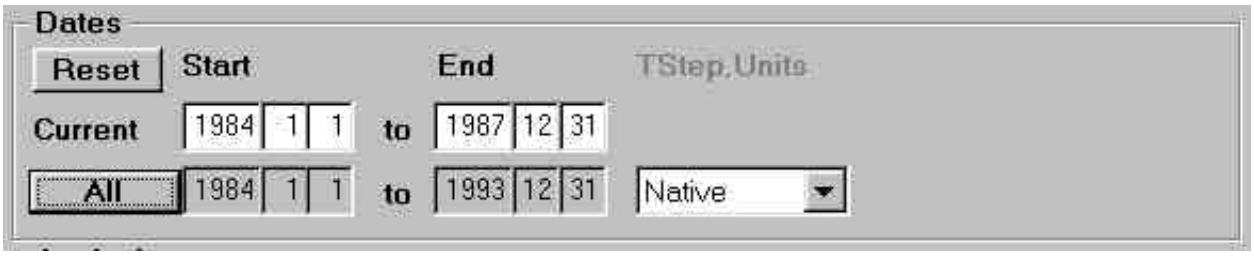

Text entered in the Header text box will be written to the file as a comment block. There are four Column Format options that determine how the output data is spaced in the text file. The Include Column Titles check box determines whether or not the list headers will be included in the text file. If the user enters text in the Empty Cell Text field then this entry will appear in place of any missing time series values. The remaining portion of the form is used to specify the output file drive, directory path, and name.

The **Load** button is used to retrieve a set of specifications that was previously saved to a file.

# Dates

The **Dates** frame of the WDMUtil form displays the period of the time series listed in the **Time Series** frame. The upper white date fields represent the **Current** time span that will be used in the analysis operations. The user may change the starting and ending dates for the analysis by clicking in one of these text boxes. After clicking in a text box, the user may type in the date. The entire date must be specified (no partial dates allowed).

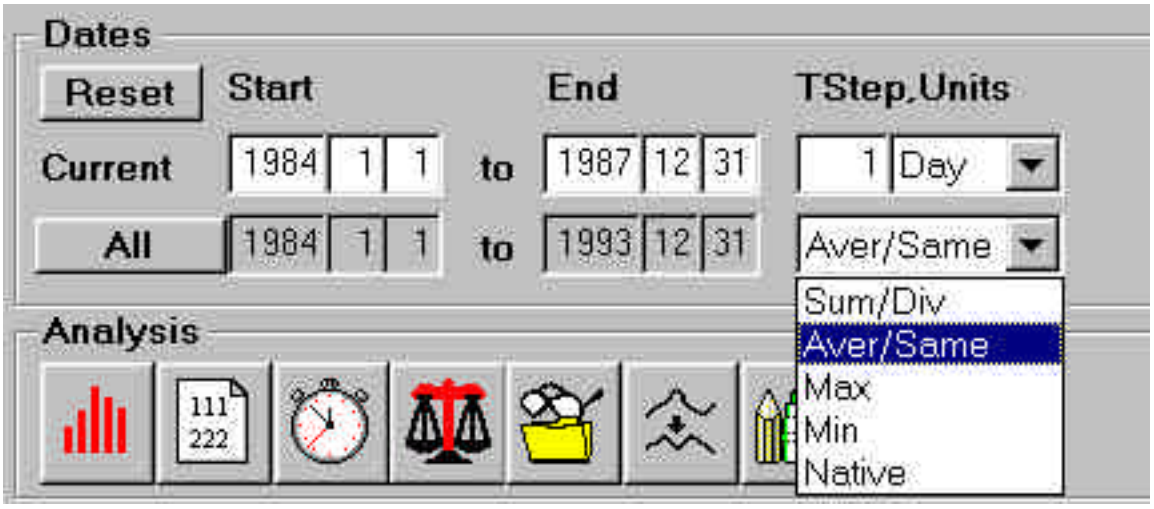
The lower, gray date fields represent the available period of the listed time series. These fields display either the common or the entire date range of the time series. If the button beneath **Current** is labeled **All** then the union of all date ranges is displayed. If the button is labeled **Common** then the intersection all date ranges is displayed.



If no time series are in the list, dates will not be available. Instead, the text *No dates are available until Time Series are Selected* will appear in the **Dates** frame.

If the time series in the time-series list do not have a common period, then dates will not be available. Instead, the text *No Common Period for Selected Time Series* will appear in the **Dates** frame.

The default time step for the listed time series is native, meaning every value in the time series is included, resulting in possibly irregular time steps. The time step can be set to a constant time interval by selecting any option other than *Native*. When the time step is set to a constant time interval, the **TStep,Units** field is activated, and the user may then select the constant time interval.



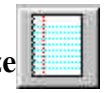

The **Reset** button changes the values in these fields back to their defaults.

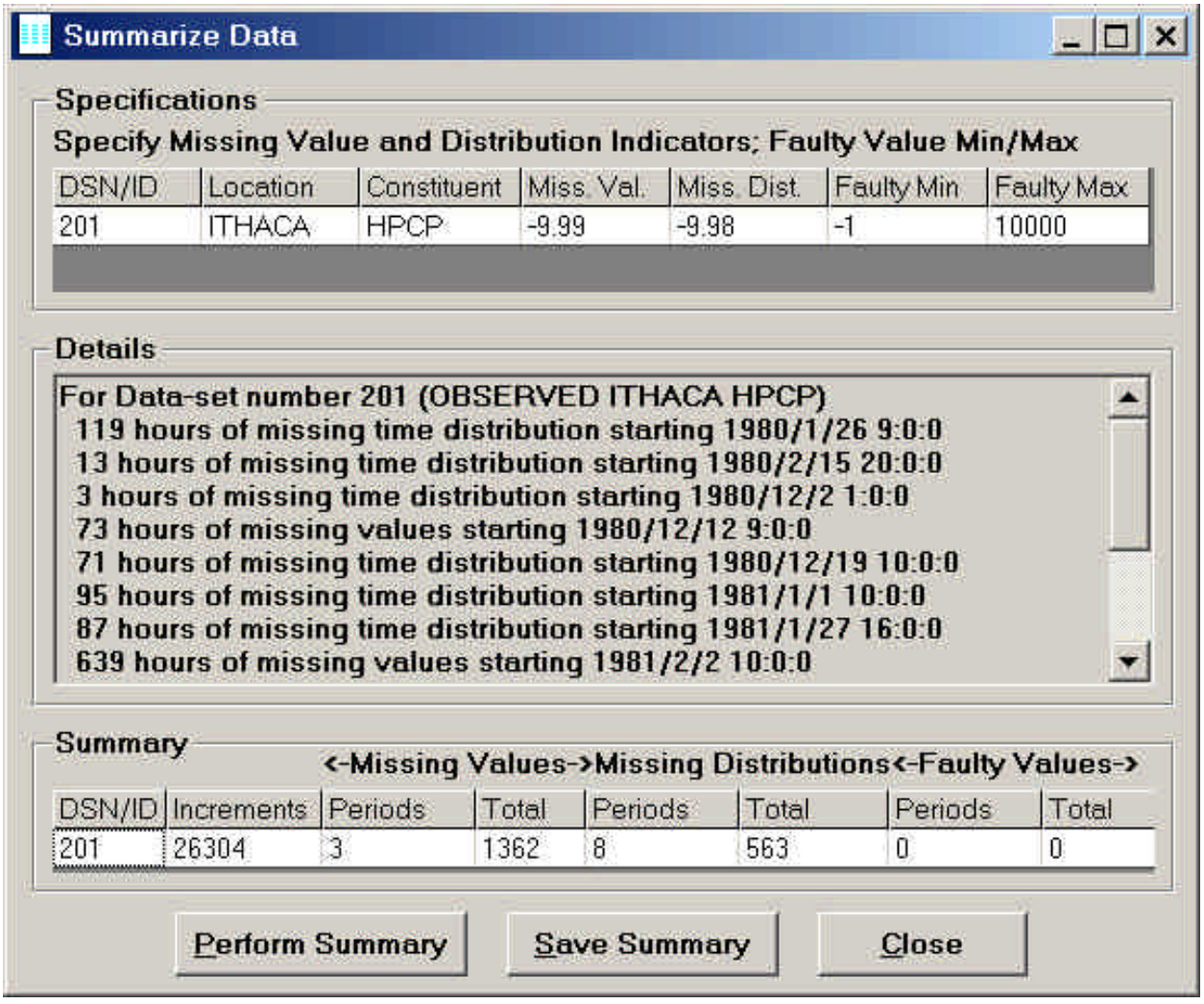
# Analyzing Data

Analysis tools may be invoked by selecting the appropriate button from the **Tools** frame located in the lower right corner of the main WDMUtil form. They may also be invoked by selecting one of the menu items under the Tools menu title. The Summarize Data , Graph , List

, and Write to WDM options require at least one time series to be selected in order to function. Neither the Compute/Disaggregate option nor the Generate option require any time series to be selected as the time series selections, if necessary, are made from the **Compute/Disaggregate** or **New Time Series** form, respectively. The Export Time Series option requires that a single time series be selected. The File View option also does not require any time series to be selected.

# Summarize Data

The **Summarize Data** form is displayed by clicking on the **Summarize**  button in the Tools frame or by selecting the *Tools:Summarize* menu item. The form is composed of three frames (**Specifications**, **Details**, **Summary**) and three buttons (**Perform Summary**, **Save Summary**, **Close**).




The **Specifications** frame contains a row of specifications for each time series being summarized. The first three columns are to help the user in identifying each time series and are not editable. The next two columns are used for defining missing value and missing time distribution (accumulated value) indicators. Time series read in using a data import script may have specified the values of these indicators. In any case, the user is responsible for defining

them here. The final two fields are used for defining a minimum and maximum range outside of which values for the given constituent would not be valid.

The **Details** frame contains a scrollable text box that reports each instance of missing, accumulated, or faulty data. For each instance, the number of time intervals, the type of problem, and the date after which it begins are reported. If a time series has no missing data, a message indicating such is displayed.

The **Summary** frame contains a row of information for each time series summarized. The first two fields indicate the data-set number and the total number of time intervals that were summarized. The next two fields display the total number of periods (or instances) of missing values and the total number of time intervals in those periods. Similar totals are reported for missing time distributions and faulty values in the ensuing fields.

The **Perform Summary** button is used to generate the missing data summary. The time series selected from the main form will be scanned for missing, accumulated, and faulty data over the period specified in the Dates frame on the main form.

The **Save Summary** button is used to output the details and summary information to a file for printing and long-term storage.

The Close button is used to remove the form.

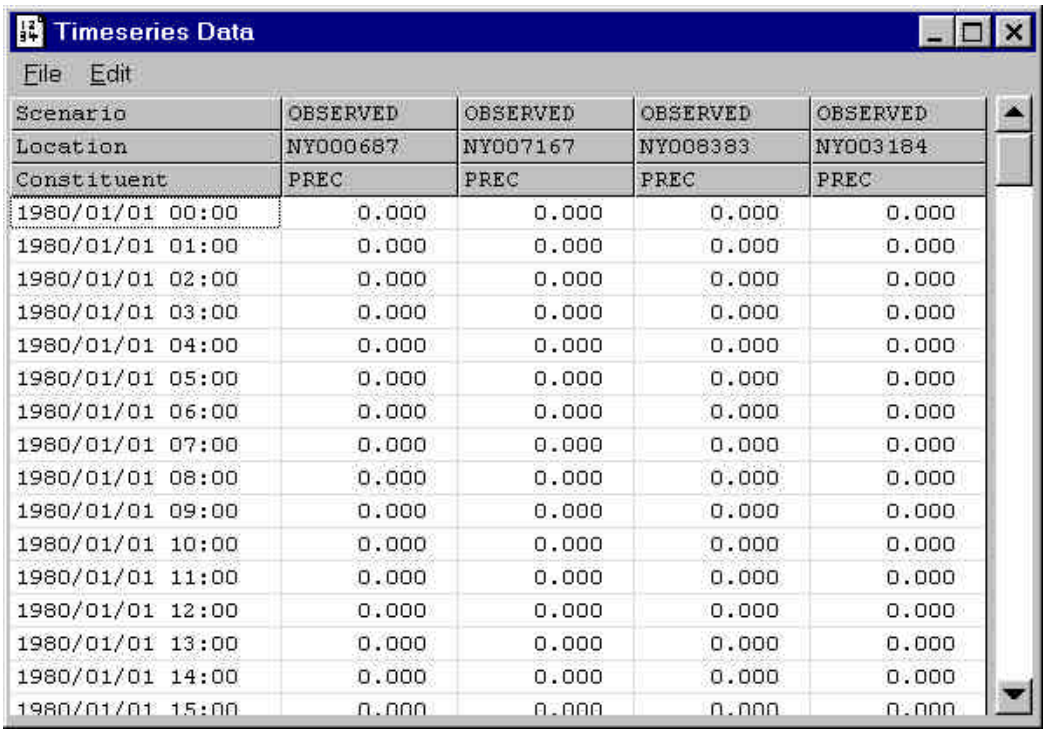
# List

The **Time Series Data** form is displayed by clicking on the **List** button on the Analysis toolbar or by selecting the *Analysis:List* menu item. The initial listing contains values for the selected time series displayed at the time interval and for the time period specified in the **Dates** frame. All lists generated by WDMUtil contain a standard set of menu items for outputting and manipulating the list. The File menu title is used to:

- create a new timeseries to add to the list
- save edits to all or selected timeseries on the form
- output the listed values to a text file or printer
- close the **Time Series Data** form

The Edit menu title is used to:

- copy and paste all or selected portions of the list
- edit the date and number format
- select and edit timeseries attributes that appear in the list header

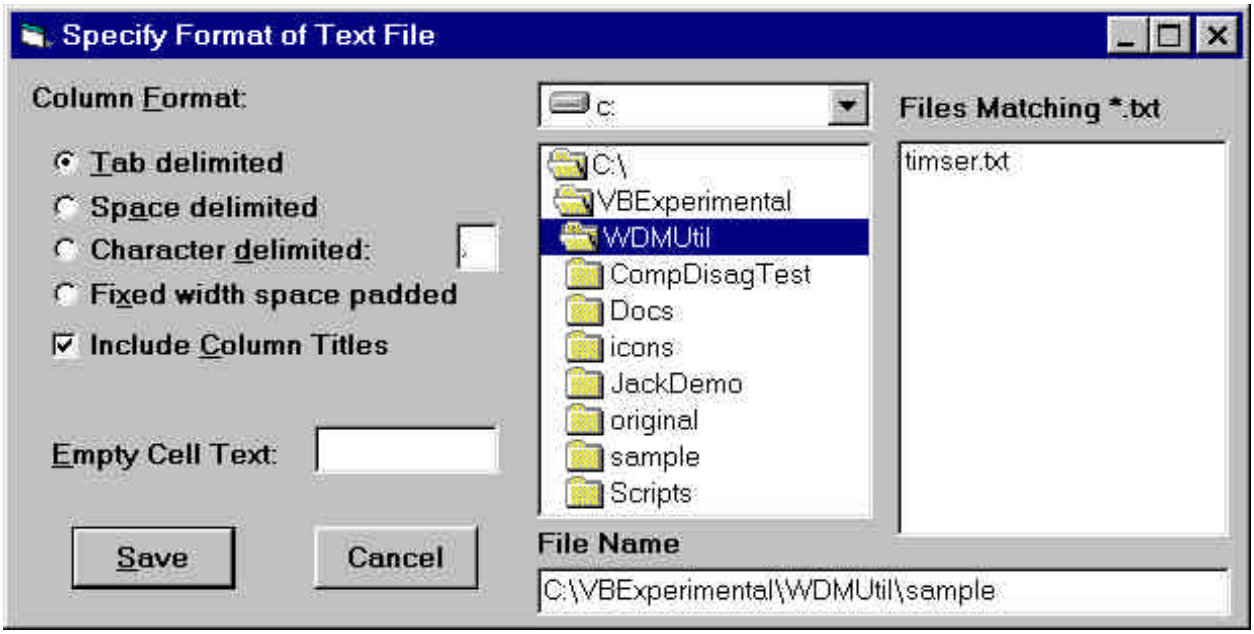



| Scenario | OBSERVED | OBSERVED | OBSERVED | OBSERVED |
|---|---|---|---|---|
| Location | NY000687 | NY007167 | NY008383 | NY003184 |
| Constituent | PREC | PREC | PREC | PREC |
| 1980/01/01 00:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 01:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 02:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 03:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 04:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 05:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 06:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 07:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 08:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 09:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 10:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 11:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 12:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 13:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 14:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 15:00 | 0.000 | 0.000 | 0.000 | 0.000 |

**List File**

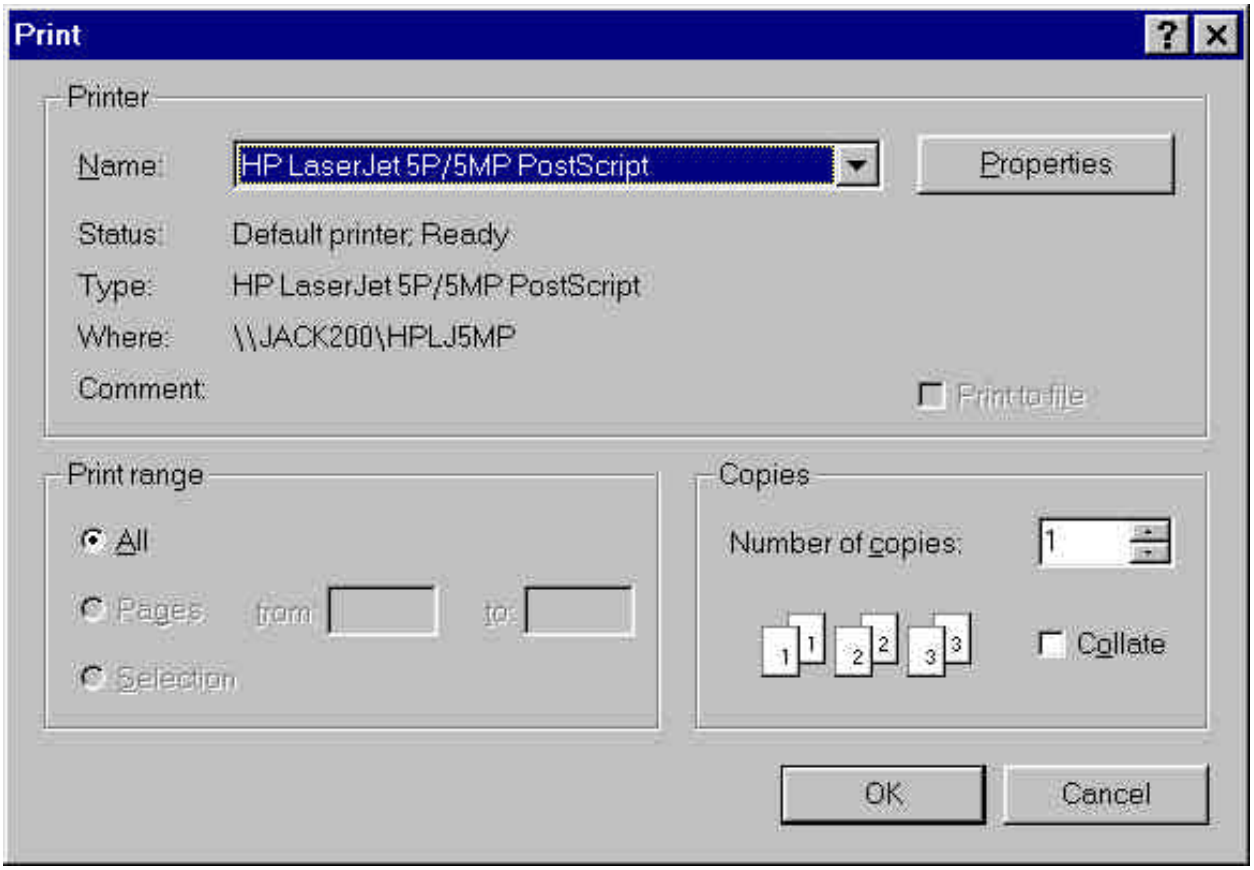
| | |
|---|---|
| **New Time Series** | Invokes the New Time Series form. The resulting time series is added to the list once created by the user. |
| **Save Changed** | Saves the changes made to all listed time series |
| **Save Selected** | Saves the changes made to the time series in the currently selected column |
| **Save Text to File** | Saves the list to an ASCII text file |
| **Print** | Sends the list to the a selected printer |
| **Close** | Closes the Time Series Data form |

When the **Save to Text File** option is selected, the following form is displayed.




There are four *Column Format* options that determine how the output data is spaced in the text file. The *Include Column Titles* check box determines whether or not the list headers will be included in the text file. If the user enters text in the **Empty Cell Text** field then this entry will appear in place of any missing time series values. The remaining portion of the form is used to specify the output file drive, directory path, and name.

The *Print* menu item causes the Print dialogue form to be displayed. The desired printer may be selected and detailed properties specifications (for example, page orientation) may be made using the **Properties** button. The number of copies to print may also be specified on this form. The OK button is used to send the list to the printer, and the Cancel button is used to abort the printing process.

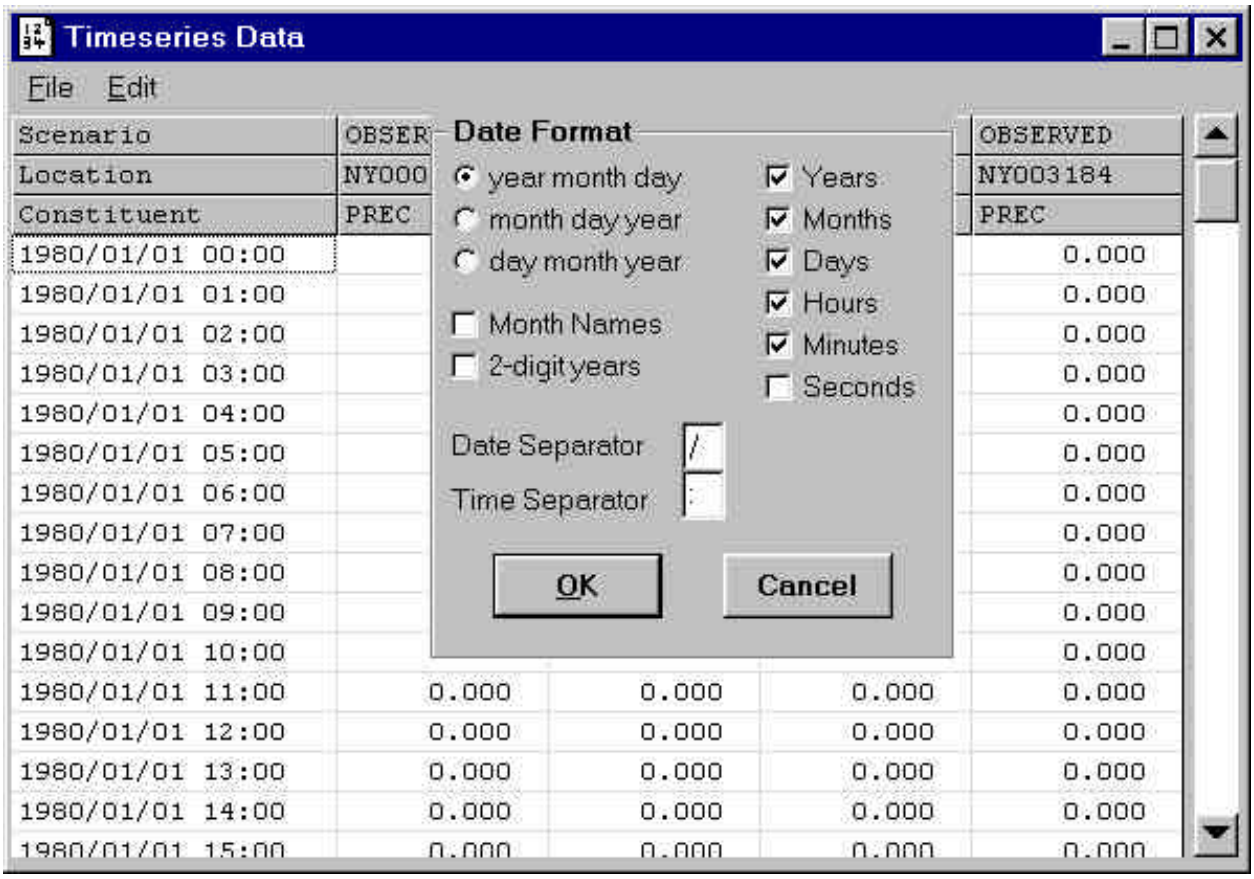



The *Close* menu item removes the **List** form from the screen.

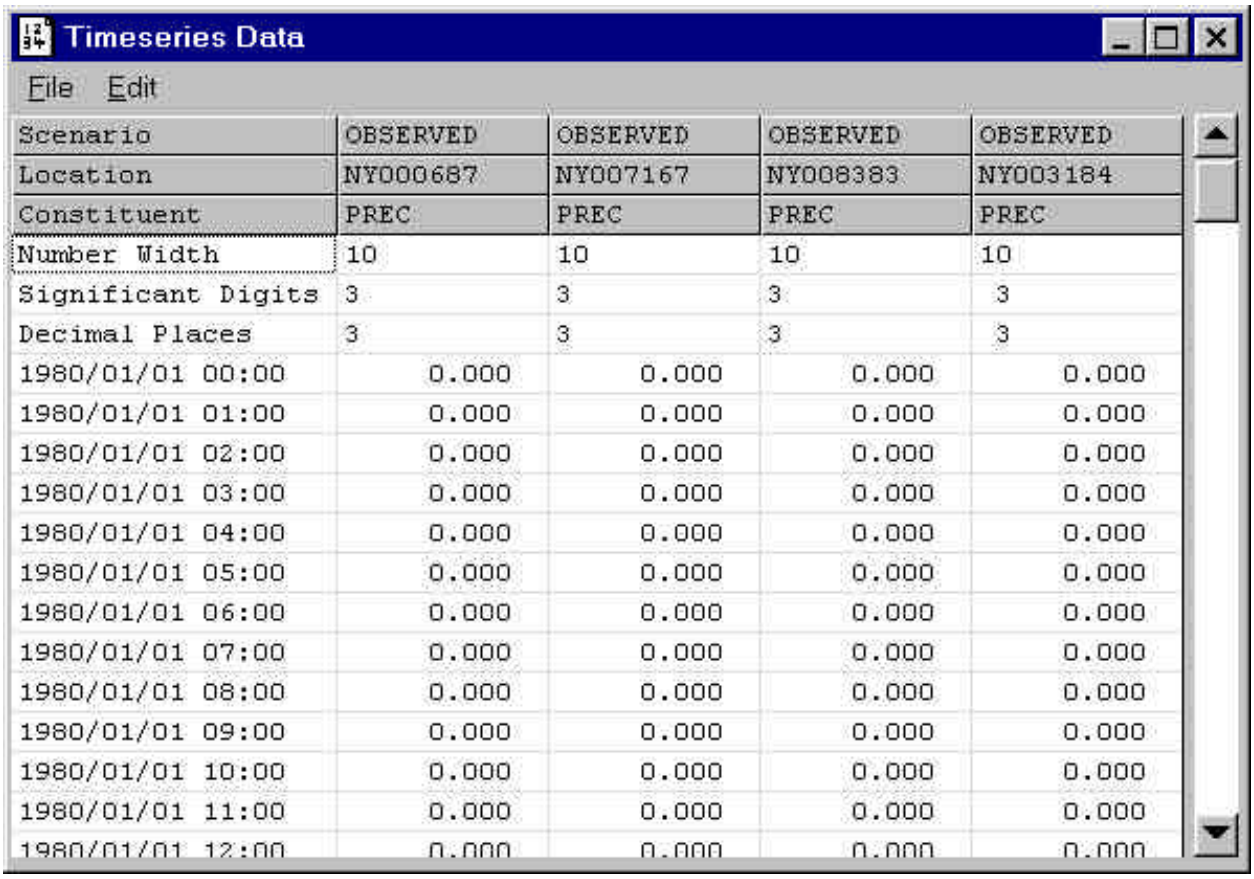
**List Edit**

| | |
|---|---|
| **Copy** | Copies selected portions of the list to the clipboard |
| **Copy All** | Copies the entire list to the clipboard |
| **Paste** | Pastes the contents of the clipboard onto the selected portion of the list |
| **Date Format** | Sets the format for date fields in the list |
| **Number Format** | Sets the format for data fields in the list |
| **Select Attributes** | Determines which of the time series attributes will be displayed as headers for the list |
| **Edit Attributes** | Edits the time series attributes to be displayed as headers for the list |

When the **Date Format** option is selected, the Date Format form is displayed. The format options on this form are self-explanatory and are applied to all listed date values.

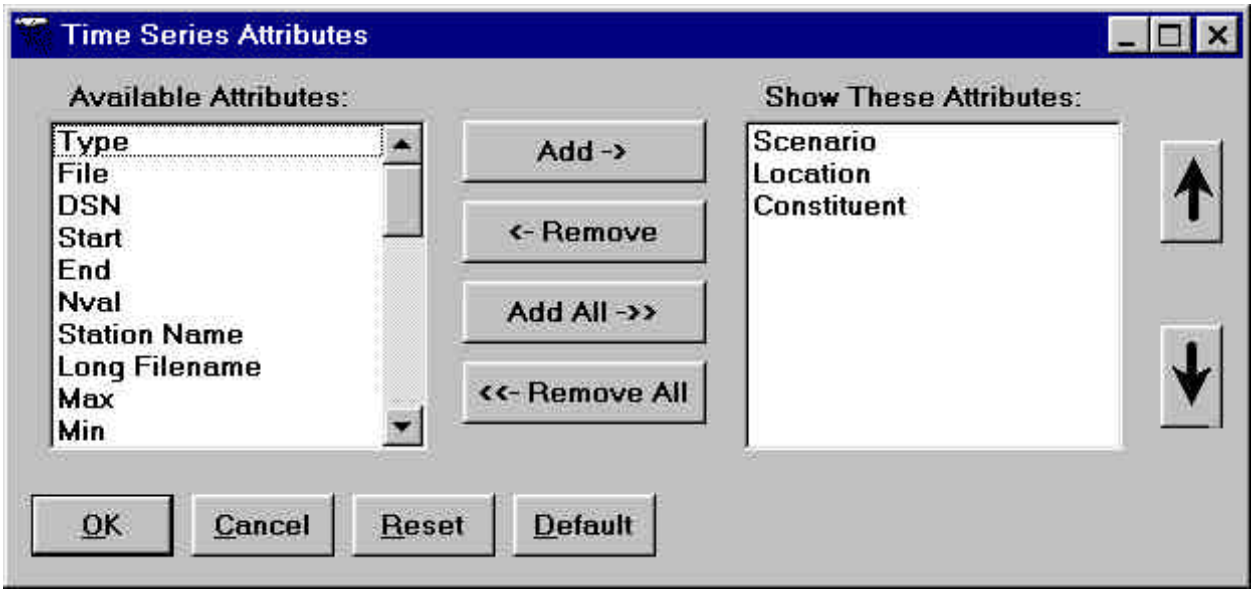



When the **Number Format** option is selected, the first three lines of each list column are dedicated to specifying the *Number Width*, *Significant Digits*, and *Decimal Places* to be displayed for each value in that column.

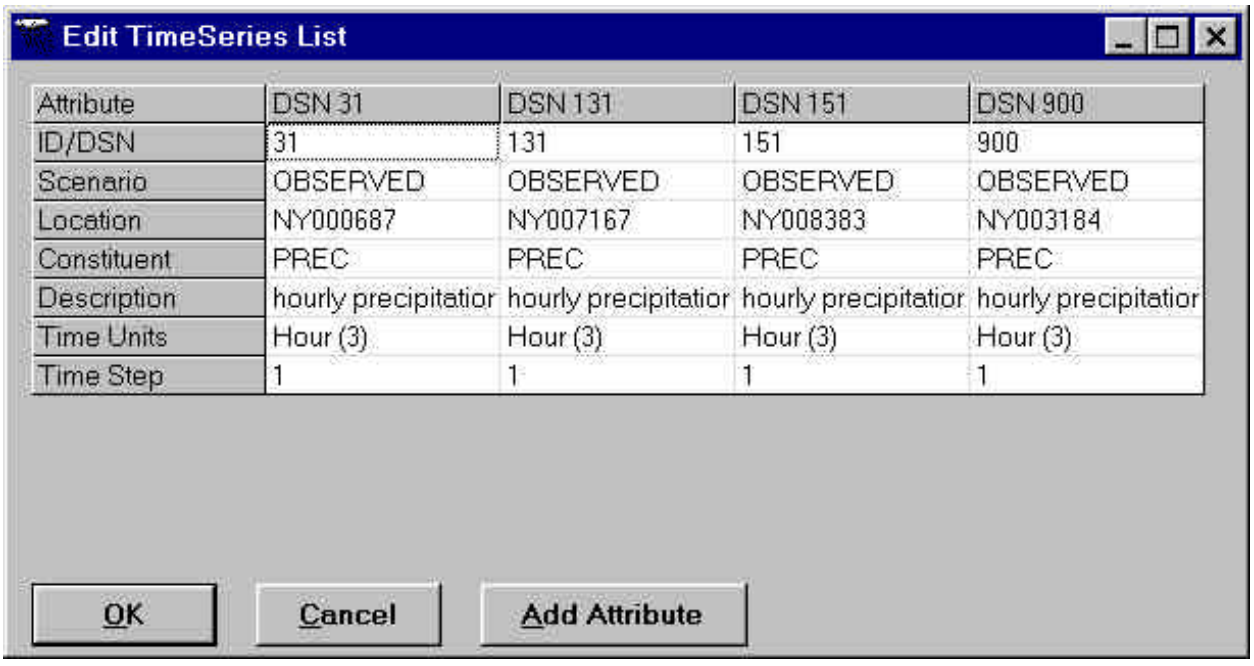



| Scenario | OBSERVED | OBSERVED | OBSERVED | OBSERVED |
|---|---|---|---|---|
| Location | NY000687 | NY007167 | NY008383 | NY003184 |
| Constituent | PREC | PREC | PREC | PREC |
| Number Width | 10 | 10 | 10 | 10 |
| Significant Digits | 3 | 3 | 3 | 3 |
| Decimal Places | 3 | 3 | 3 | 3 |
| 1980/01/01 00:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 01:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 02:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 03:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 04:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 05:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 06:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 07:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 08:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 09:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 10:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 11:00 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1980/01/01 12:00 | 0.000 | 0.000 | 0.000 | 0.000 |

When the **Select Attributes** option is selected, the Time Series Attributes form appears. The user can select which attributes of the listed time series are to be included in the list header. In order to select an item from a list, either double-click on the item, or single-click on the item then click the Add or Remove button. To add all of the Available areas to the Selected list, click the Add All button. To return all of the areas from the Selected list to the Available list, click the Remove All button.




When the **Edit Attributes** option is selected, the Edit Time Series List form appears. The user can type in new text descriptions or numeric identifiers for the various timeseries being listed. The Add Attribute button at the bottom of the form creates a new attribute associated with the listed time series. A blank line at the bottom of the form is created to facilitate manual entry of the attribute name and its value for each time series.

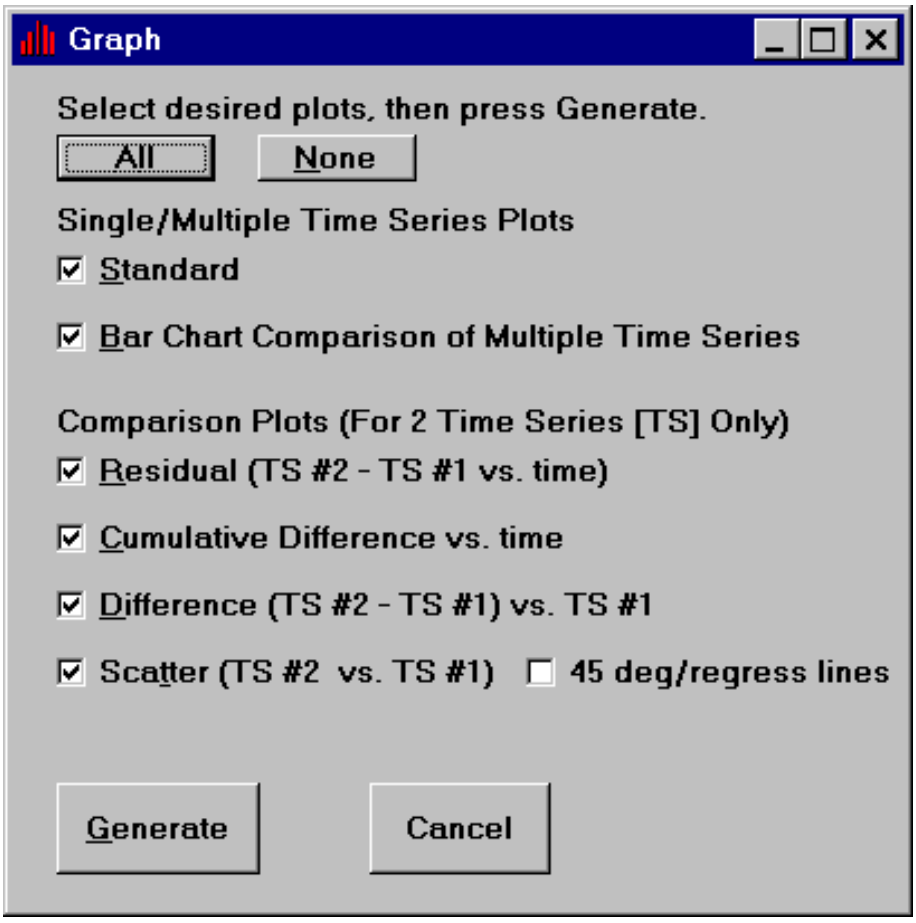


# Graph

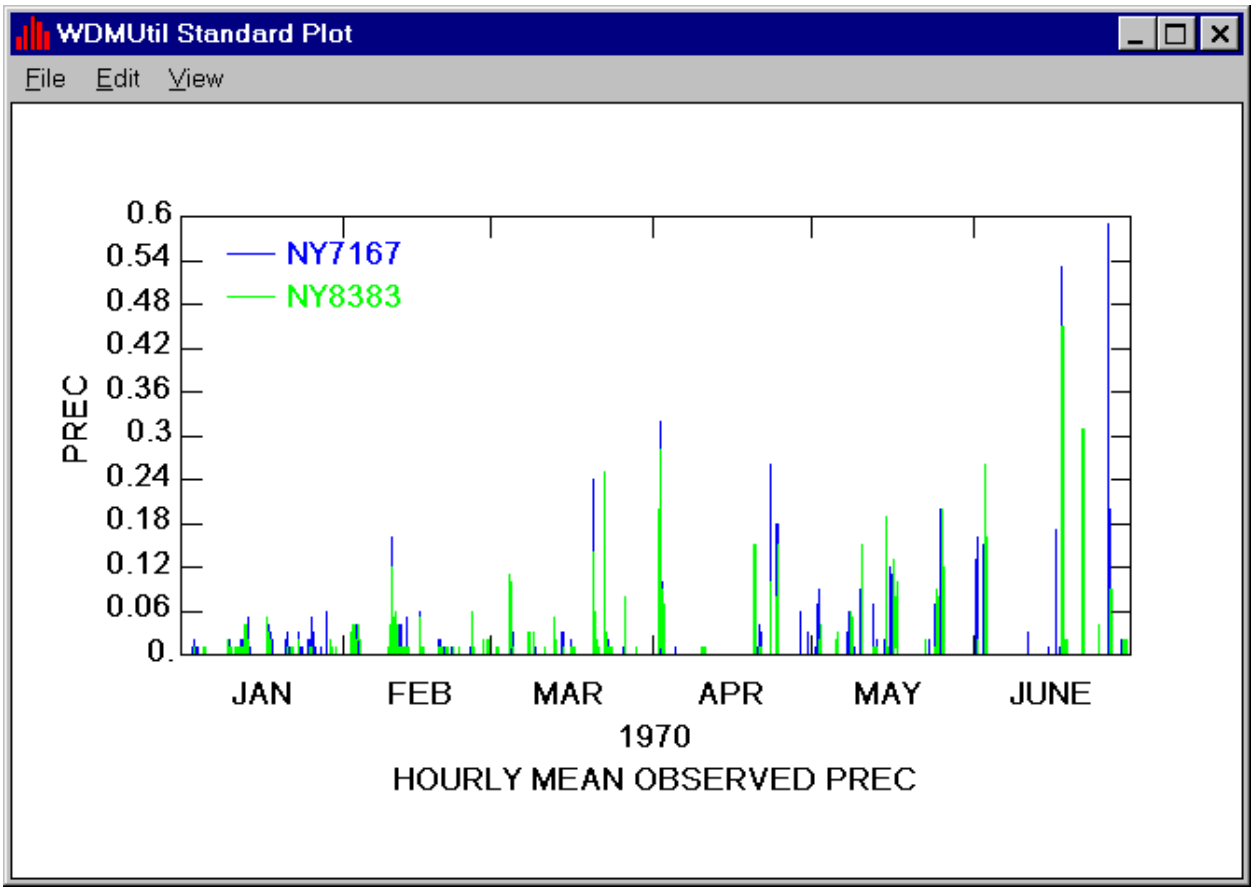
The Graph tool allows the user to generate a variety of plots for graphically viewing time-series data. All of the plots are based on time-series data, but only the Standard, Bar Chart, Residual, and Cumulative Difference, plots are time plots. The Difference and Scatter plots are x-y plots. The Standard plot will plot a single or multiple time series at one time. The Bar Chart plot will display two or more time series side by side over time. The remaining comparison plots use only two time series. If more than two time series are selected for plotting, only the first two will be used when generating the comparison plots.

Time plots (standard, bar chart, residual, and cumulative difference) can be plotted at time intervals other than the time series' native time steps, which includes every value in the time series despite possibly irregular time steps. The time interval for the plots is specified in the **Tstep,Units** fields in the **Dates** frame. Available time interval aggregation/disaggregation options include summing, averaging, dividing, reporting the minimum or maximum value, and native. To view a chart on how the aggregation options control the resulting plot, see the help section on changing intervals.

The **Graph** form is displayed by clicking on the **Graph** button in the **Tools** frame or by selecting the *Analysis:Graph* menu item. The **Graph** form shows the suite of graphs that may be generated. If there is only one time series selected, then only the Standard plot is available as the remaining plots require multiple time series. The **All** button selects all of the available plots for plotting and the **None** button deselects them. The **Generate** button causes all of the selected plots to be created. The Cancel button closes the Graph form, but will not close any existing plots.


Graph
Select desired plots, then press Generate.
All
None
Single/Multiple Time Series Plots
Standard
Bar Chart Comparison of Multiple Time Series
Comparison Plots (For 2 Time Series [TS] Only)
Residual (TS #2 - TS #1 vs. time)
Cumulative Difference vs. time
Difference (TS #2 - TS #1) vs. TS #1
Scatter (TS #2 vs. TS #1)
45 deg/regress lines
Generate
Cancel

All graphs generated by WDMUtil contain a standard set of menu options for outputting and manipulating the graph. The File menu is used to output the graph to a printer or Windows metafile and to close the graph form. The Edit menu is used to manipulate the components of the graph (that is, curves, axes, labels, and so forth). The View menu is used to generate a listing of the graph in a new form.




**Menu**

All graphs generated by WDMUtil contain a standard set of menu options for outputting and manipulating the graph. The File menu is used to output the graph to a printer or Windows metafile, save the specifications from this graph to a *.grf file, recall the specifications from a *.grf file, or to close the **Graph** form. The Edit menu is used to manipulate the components of the graph (that is, curves, axes, labels, and so forth). The View menu is used to generate a listing of the graph in a new form.

**Graph File**

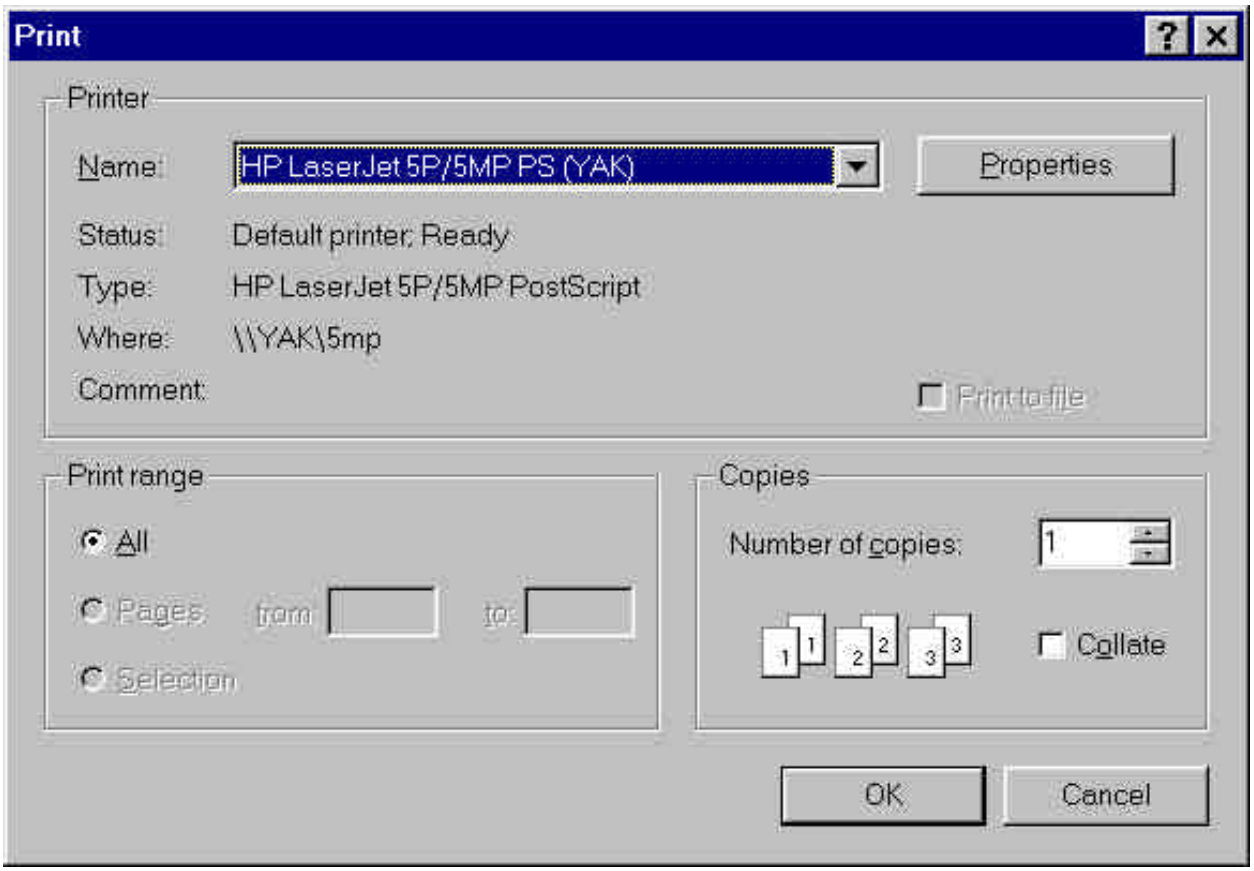
The File menu allows the user to:

- print the graph
- save the image as a Windows metafile

- save the metafile specifications as a file
- open a metafile specifications file
- close the graph

### Graph File Print

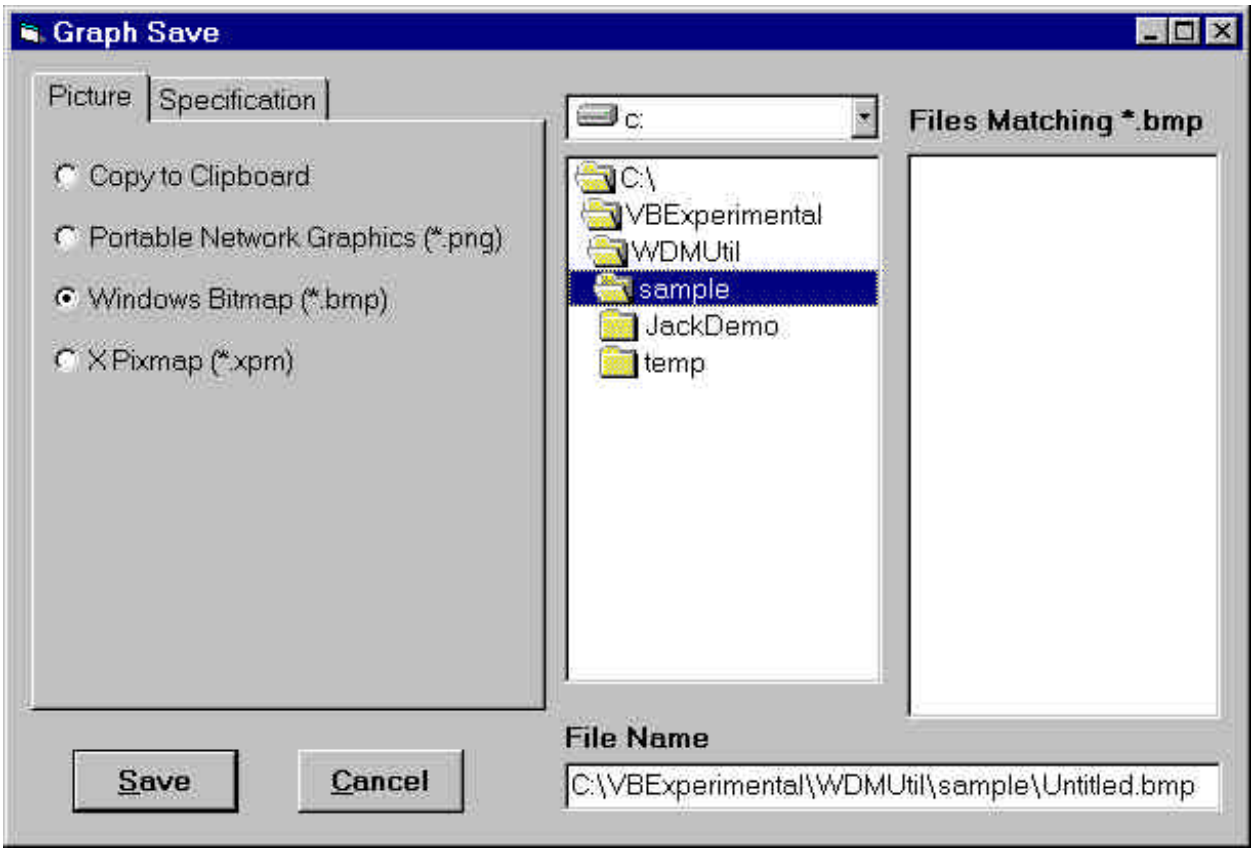
The *Print* menu item causes the **Print** common dialog to be displayed. The desired printer may be selected and detailed properties specifications (for example, page orientation) may be made using the **Properties** button. The number of copies to print may also be specified on this form. The OK button is used to send the graph to the printer, and the Cancel button is used to abort the printing process.



### Graph File Save

The *Save* menu item causes the **Windows Graph Save** dialog form to be displayed. The **Picture** tab of this form allows the user to save the graph as one of four file types or to copy the picture to the clipboard. The **Specifications** tab of this form allows the user to save properties of the current graph so that those properties can later be recalled and applied to other graphs via the Open Specification item under File on the main menu of the graph form.

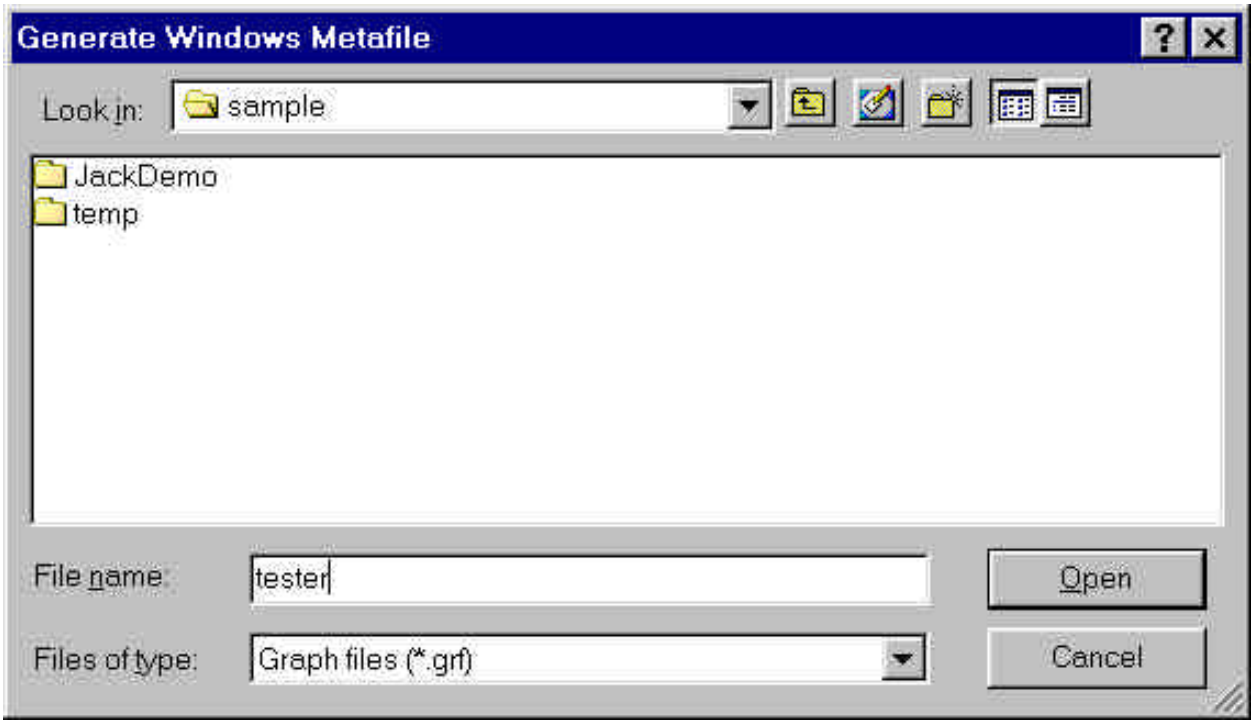
The remaining portion of the form serves the same purpose whether the user is saving the graph as a picture or saving the graph specifications. The list box at the top of the form specifies the drive in which to save the file. The middle list box illustrates the path to the current directory on the specified drive. The **Files Matching** list box lists the files in the current directory that match the specified file type. Once the user has selected a file, the **File Name** list box at the bottom of the screen will display the full path name of that file.




### Open Specifications

The *Open Specifications* menu item causes the **Generate Windows Metafile** dialog form to be displayed. This item allows the user to recall a set of saved properties from a graph file (*.grf) for application to the current graph. The list box on the top portion of the form is used to specify the directory path to the graph file. The box in the middle portion of the form displays any

existing files of the specified type in the specified directory. The **File Name** text box is used to enter the name of the graph file.




**Graph File Close**

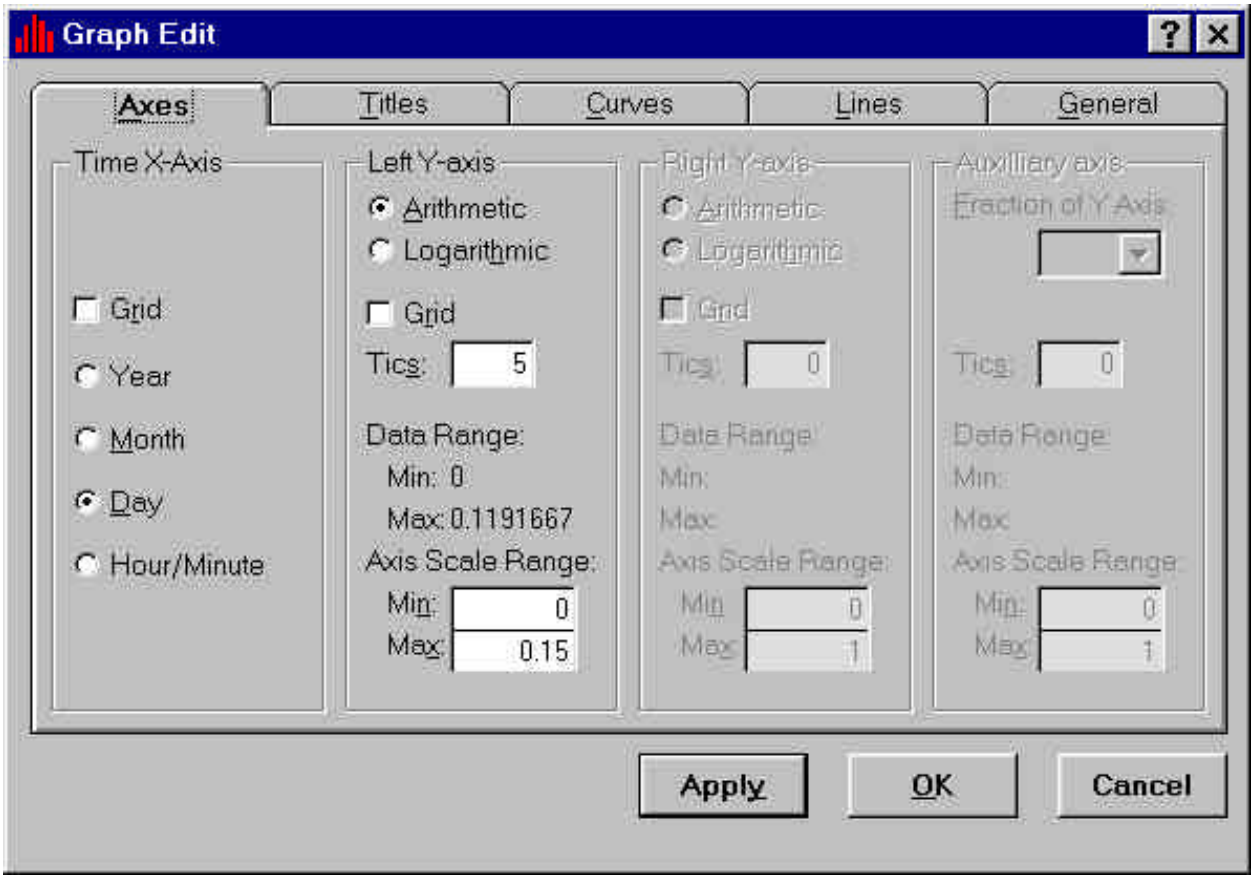
The *Close* menu item removes the **Graph** form from the screen.

**Graph Edit**

The **Graph Edit** form is displayed when any of the first five menu items under the Edit menu title is selected. The form contains five tabs (**Axes**, **Titles**, **Curves**, **Lines**, and **General**) with the tab corresponding to the selected menu item being in the forefront. When a graph is first drawn it is given default values for all these parameters.

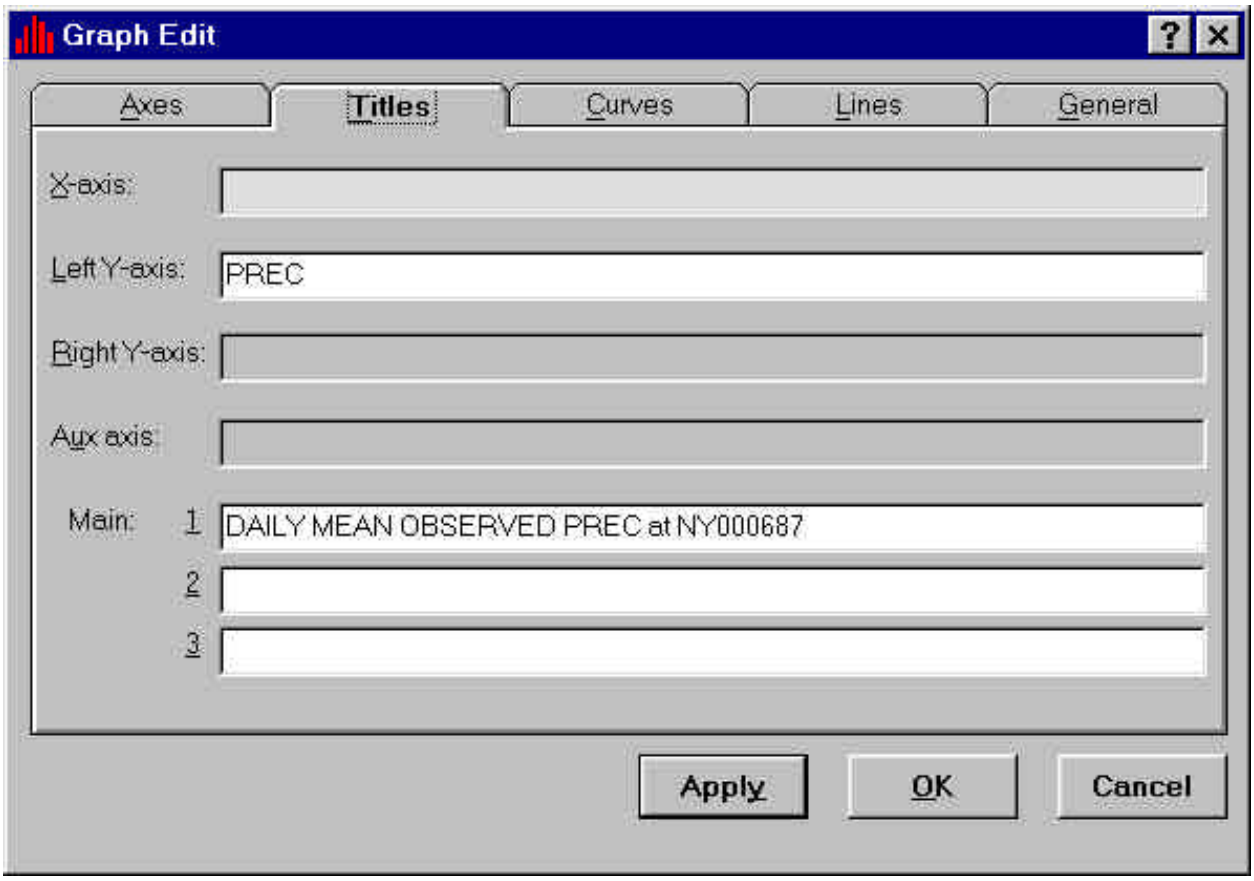
### Graph Edit Axes

The **Axes** tab contains radio buttons for selecting the type of X-, Left Y-, and Right Y-axes. An auxiliary axis is a separate graph above the main graph that shares the same X-axis. A field for specifying the fraction of the available Y space to use for the auxiliary axis (if it is in use) is also provided. Each axis frame contains fields for specifying the number of tics and the minimum and maximum value for the axis. To assist in defining the axis scale, the data range for each axis is also provided. Should values exceed the axis scale range, the curve will be clipped at that point.



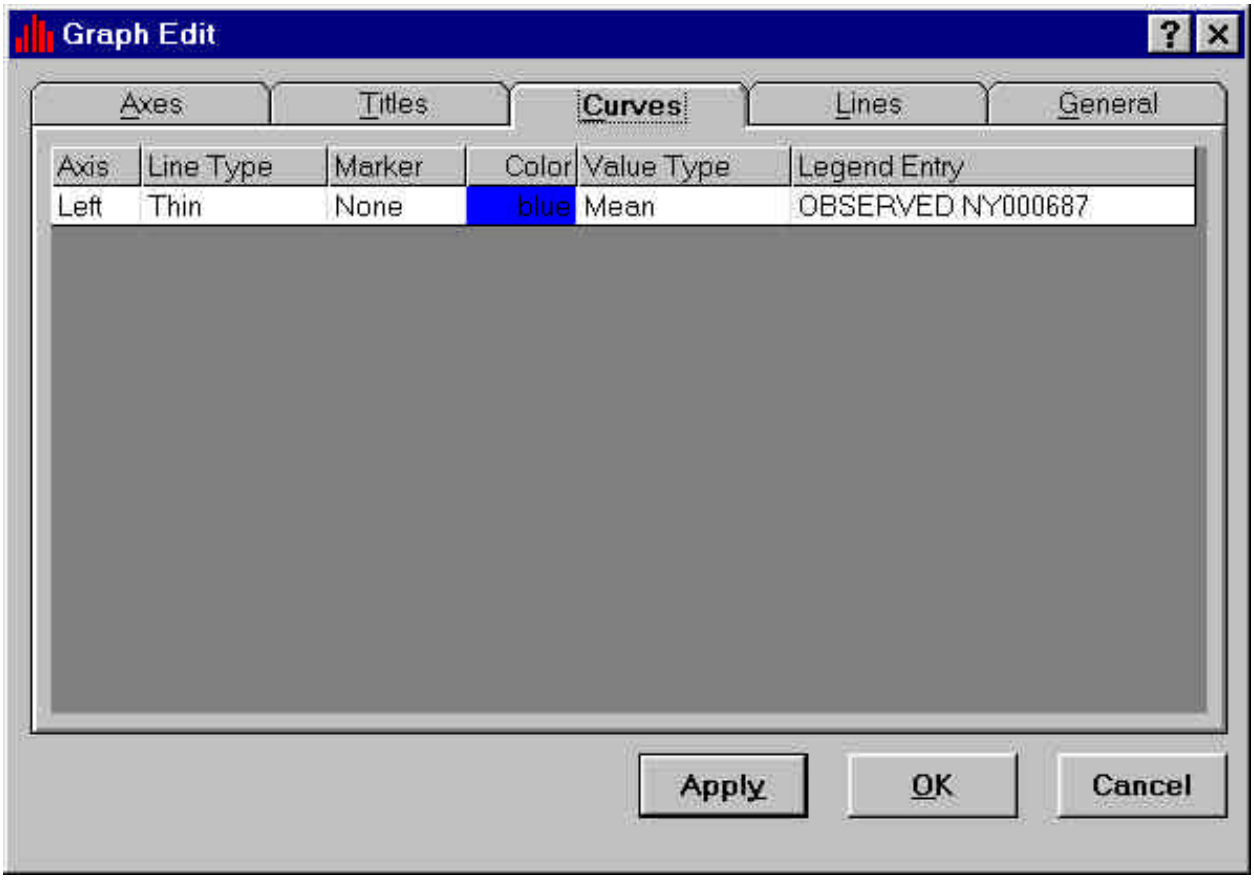
### Graph Edit Titles

The **Titles** tab contains fields for specifying axes labels and the graph title. If an axis is not active, the field for its label is also not active. For a time-series plot, the X-axis label is generated automatically. Up to three lines may be entered for the main title. An additional line may be created for the left and right Y-axes labels by inserting an & symbol that indicates the start of a new line. Two additional lines may be added to the auxiliary axis label in the same manner.



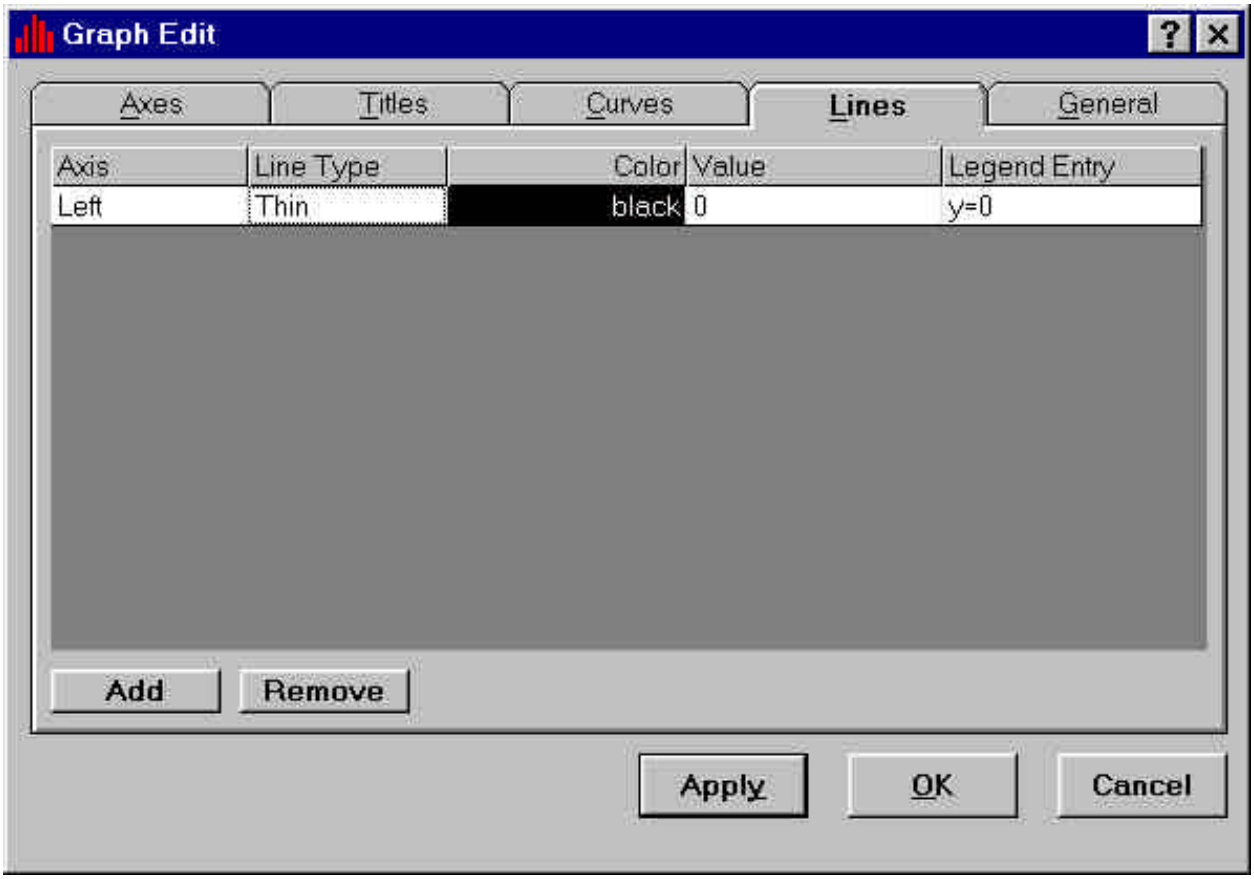
### Graph Edit Curves

The **Curves** tab contains six columns for specifying characteristics of each curve on the plot: Axis, Line Type, Marker, Color, Value Type, and Legend Entry. Curves can be identified by their current color. Double-click any field to edit selections. The *Axis*, *Line Type*, *Marker*, and *Value Type* columns all contain lists with the available options. A palette with the available colors will appear for the Color column. The **Axis** field specifies on which axis the curve is to be plotted (Left Y, Right Y, Auxiliary). Specifications for line type and thickness, marker type, color, value type (mean over a time span or point at an instant of time), and legend label may also be made.



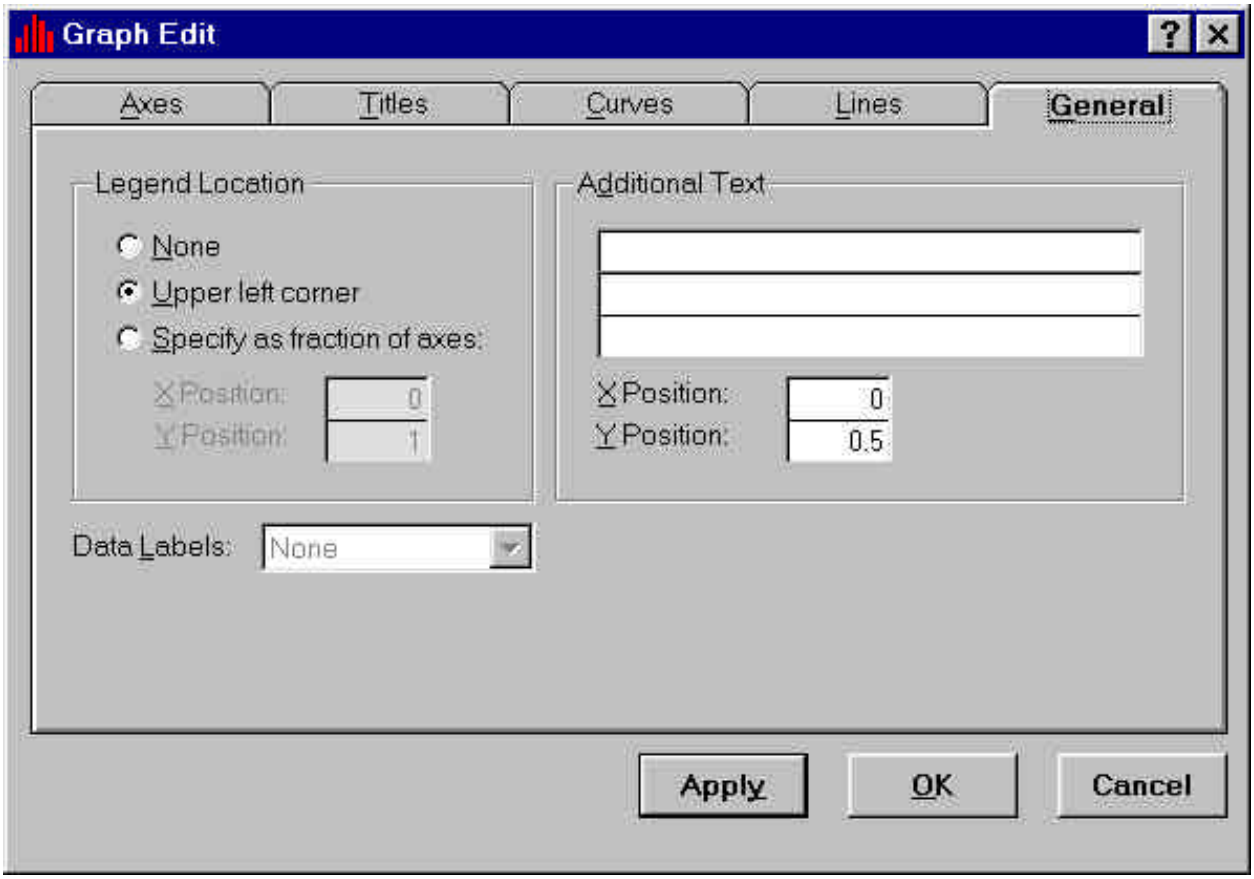
### Graph Edit Lines

The **Lines** tab contains five columns for specifying characteristics of each line on the graph: *Axis*, *Line Type*, *Color*, *Value*, and *Legend Entry*. A line is distinguished from a curve by the fact that a curve represents data values while lines merely provide a reference marker (i.e., y=0). Double-click any field to edit selections. The *Axis* and *Line Type* columns contain drop-down lists with the available options. A palette with the available colors will appear for the *Color* column. Values are typed in for the *Value* and *Legend Entry* columns.



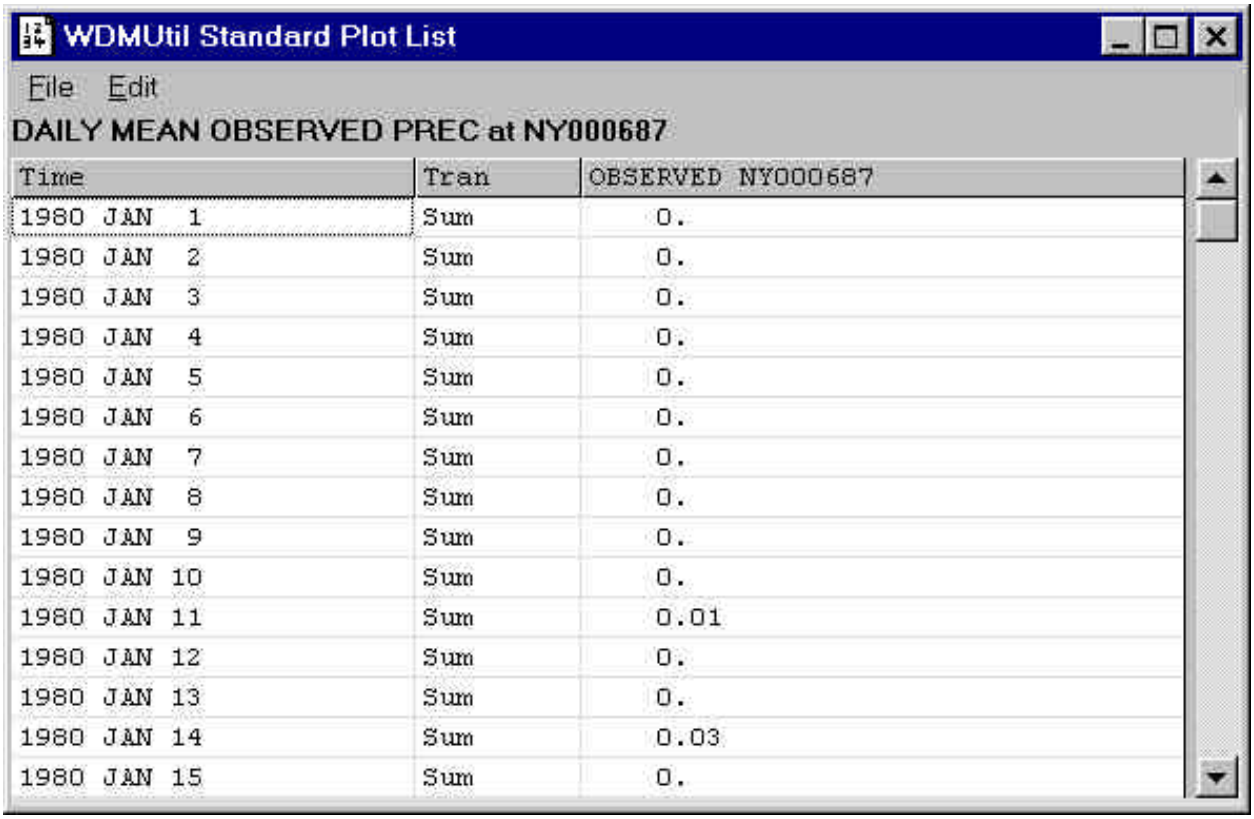
### Graph Edit General

The **General** tab contains radio buttons and fields for specifying the location of the legend. Location options include no legend, the upper left corner (default), and a user-specified location. Three additional text fields are provided to add any additional text to the plot. Location specifications for both the legend and the additional text are made by entering the fraction of the X- or Y-axis (for example, X Position=0.5, Y Position=1.0 means half way across the X-axis and at the top of the Y-axis).



## Graph View

The **Graph View** menu title contains the **Listing** menu item, which creates a text listing of the data that are plotted on the graph. For a time-series plot, the first column of the listing displays the date and time and the remaining columns display the values for each curve. For x-y plots, first the y and then the x data for each curve are displayed.



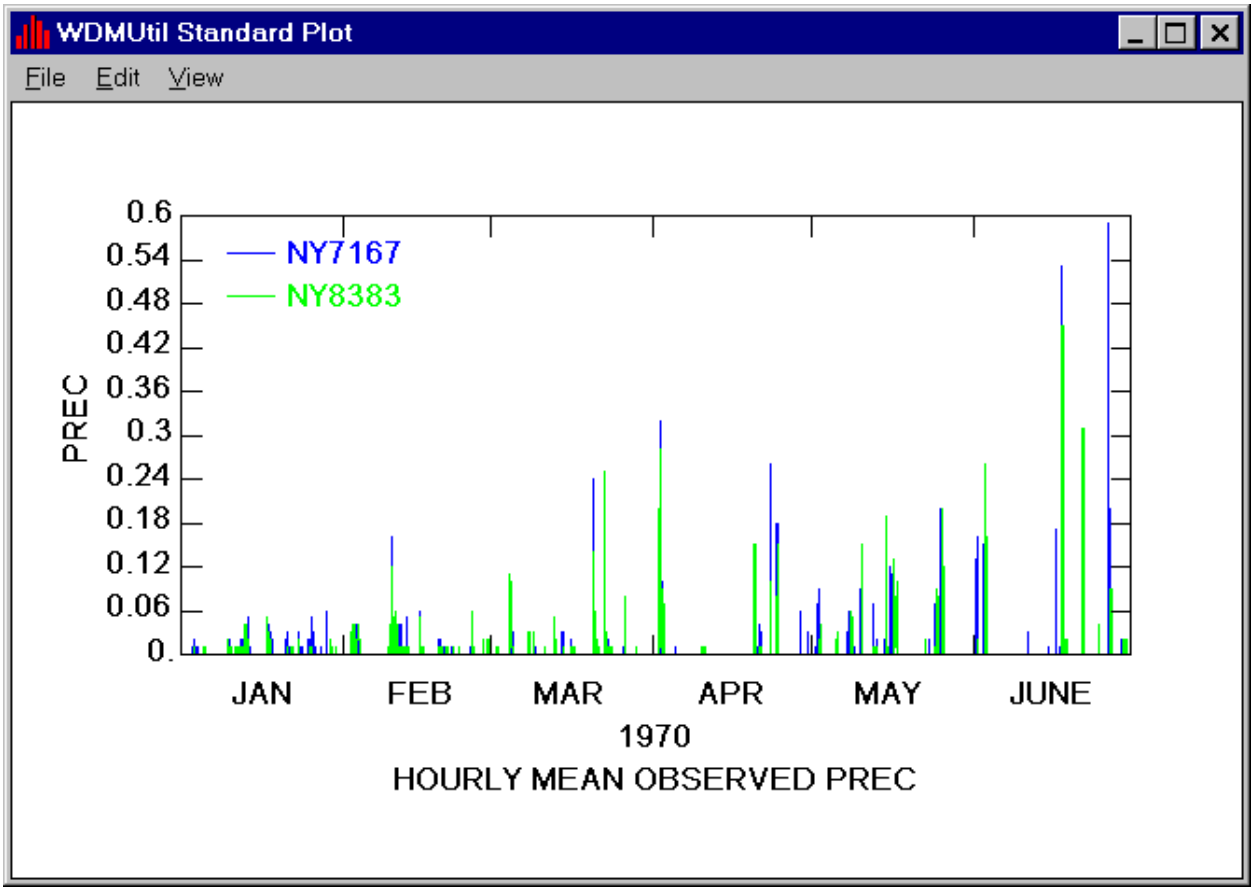

| Time | Tran | OBSERVED NY000687 |
|---|---|---|
| 1980 JAN 1 | Sum | 0. |
| 1980 JAN 2 | Sum | 0. |
| 1980 JAN 3 | Sum | 0. |
| 1980 JAN 4 | Sum | 0. |
| 1980 JAN 5 | Sum | 0. |
| 1980 JAN 6 | Sum | 0. |
| 1980 JAN 7 | Sum | 0. |
| 1980 JAN 8 | Sum | 0. |
| 1980 JAN 9 | Sum | 0. |
| 1980 JAN 10 | Sum | 0. |
| 1980 JAN 11 | Sum | 0.01 |
| 1980 JAN 12 | Sum | 0. |
| 1980 JAN 13 | Sum | 0. |
| 1980 JAN 14 | Sum | 0.03 |
| 1980 JAN 15 | Sum | 0. |

## Graph Types

Several types of plots can be generated: standard, bar chart, residual, cumulative difference, difference, and scatter.

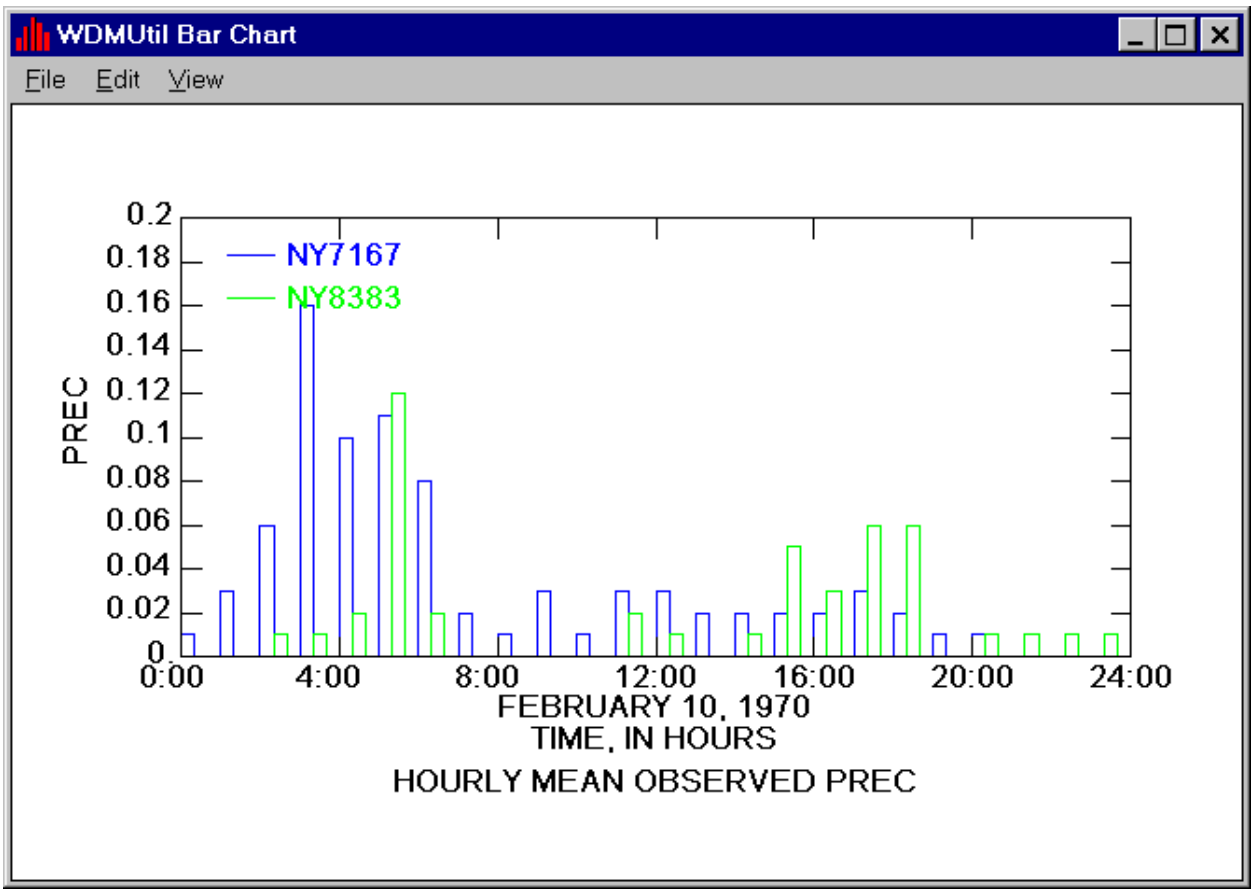
## Standard

The Standard plot creates a time plot of the selected time series. All time series are plotted on an arithmetic scale on the left Y-axis by default. Once the plot is created, the axis types and which curves are plotted on them may be modified. A limit of 18 time series may be plotted on a single graph.



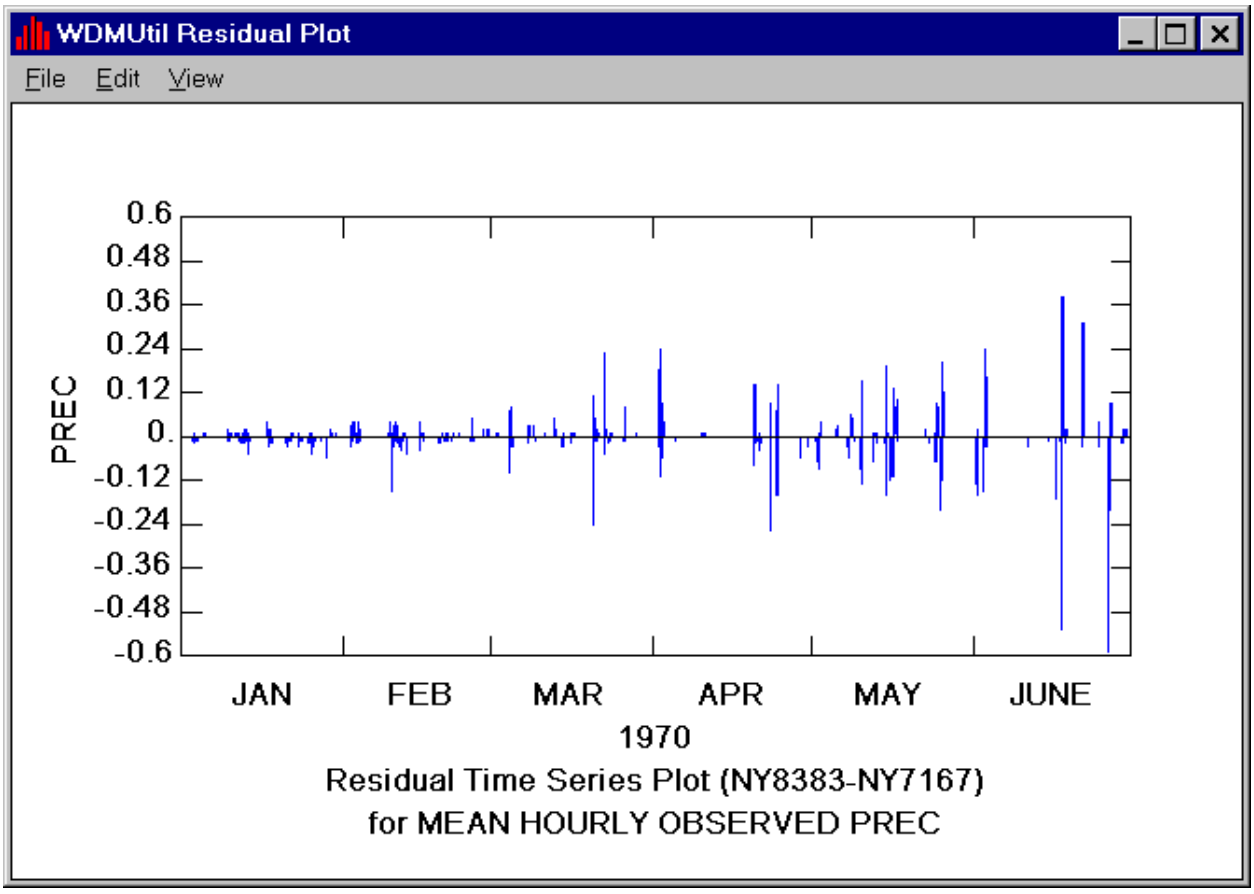
## Bar Chart

The Bar Chart plot creates a time plot that shows the value from each time series side by side for each time interval. This plot is intended for close examination of values over a short period of time. The plot will lose any useful resolution for longer time spans (for example, greater than 50 time intervals).



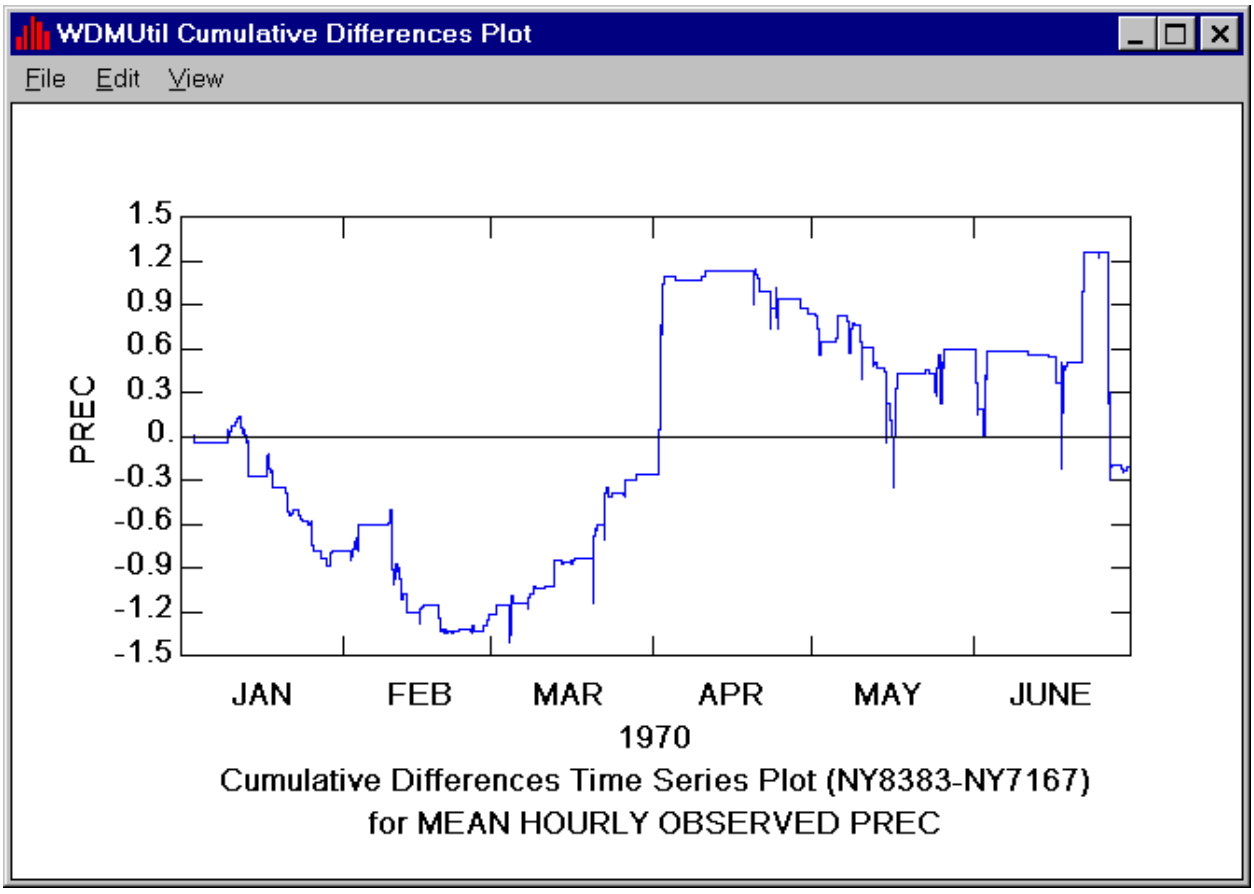
## Residual

The Residual and Cumulative Differences plots create time plots of the difference between the second and first selected time series. The Residual plot displays the difference between the two time series at each time interval, whereas the Cumulative Differences plot displays the accumulated difference through time between the two time series. If more than two time series are selected, only the first two in the time-series list will be used for these plots.



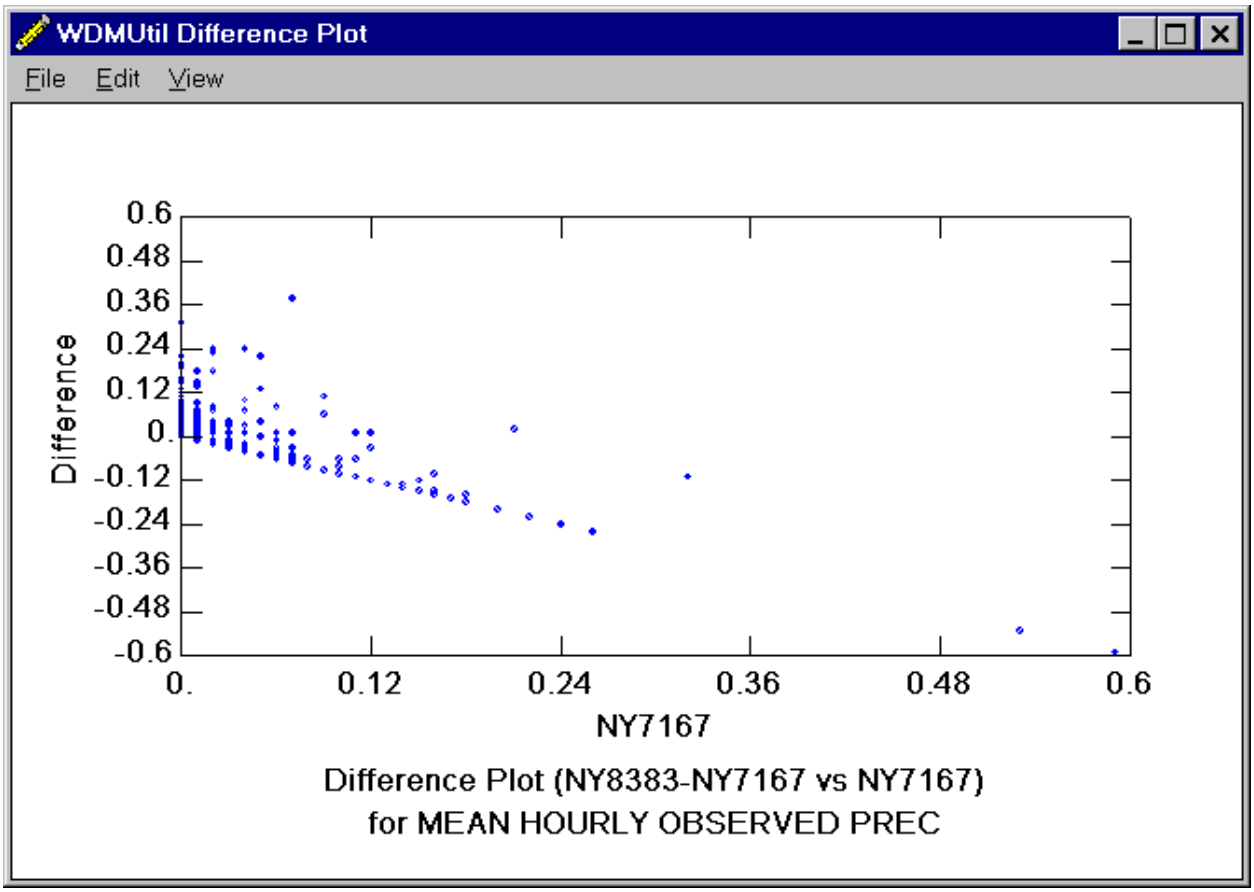
### Cumulative

The Residual and Cumulative Differences plots create time plots of the difference between the second and first selected time series. The Residual plot displays the difference between the two time series at each time interval, whereas the Cumulative Differences plot displays the accumulated difference through time between the two time series. If more than two time series are selected, only the first two in the time-series list will be used for these plots.



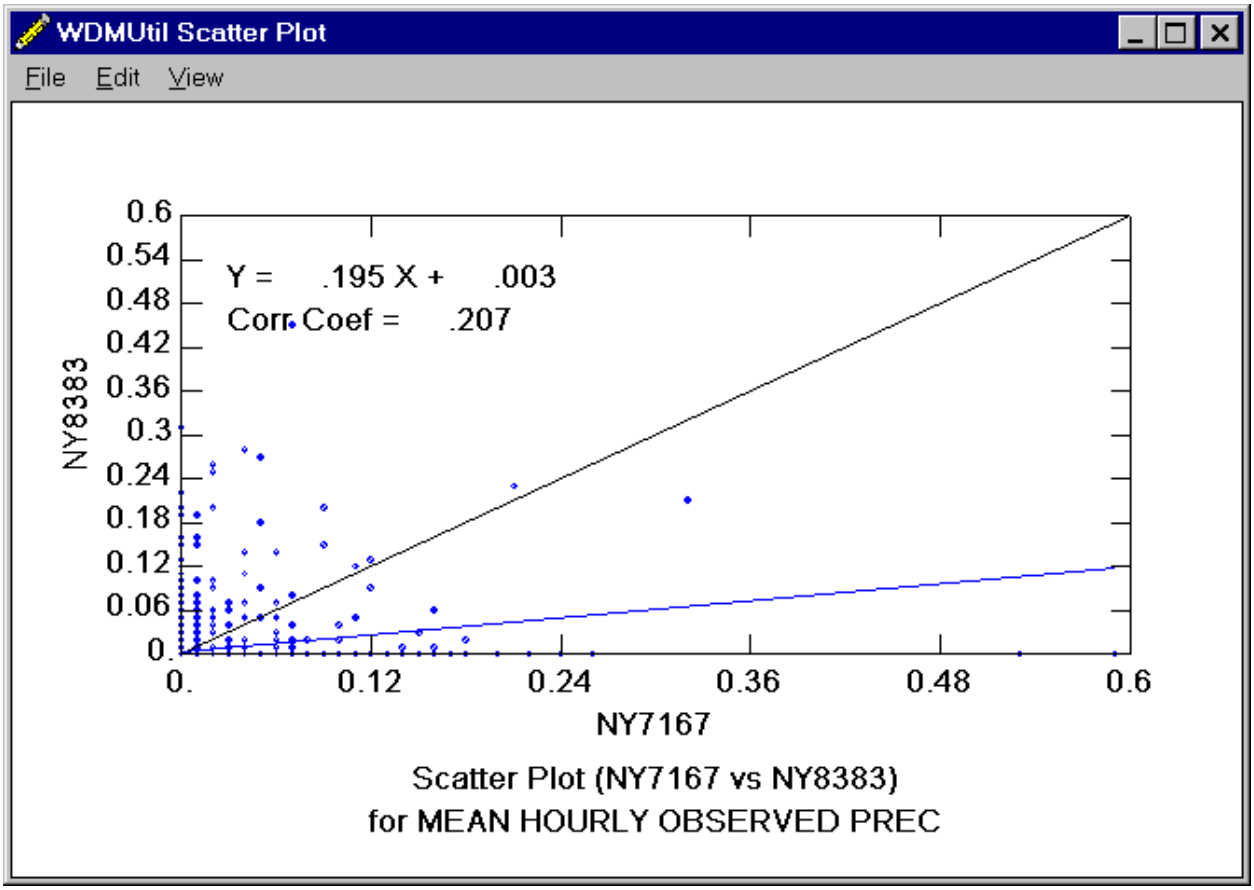
### Difference

The Difference plot creates x-y plots using the first two selected time series. The difference between the two time series is plotted against the first time series. If more than two time series are selected, only the first two in the time-series list will be used for this plot.



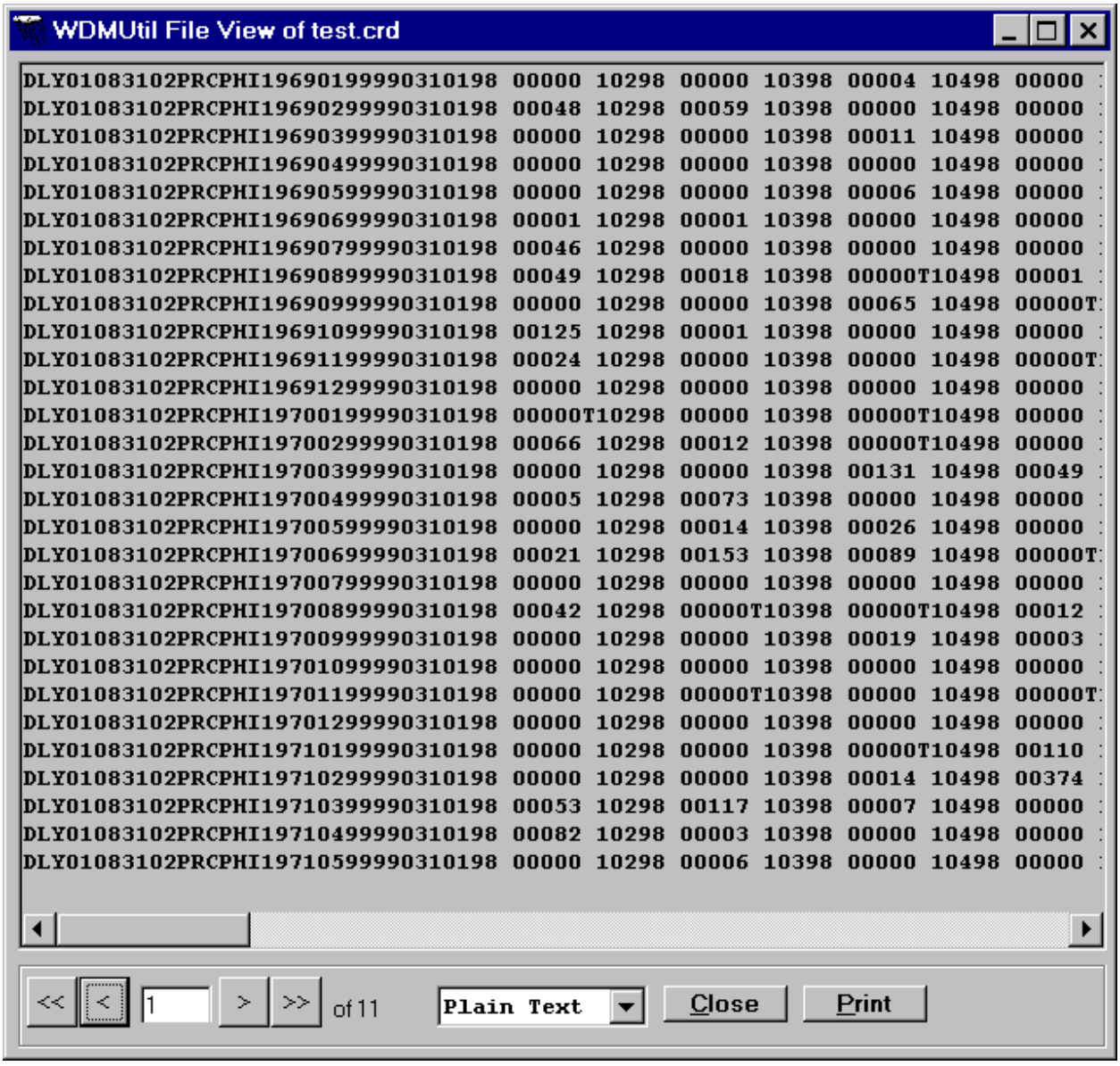
**Scatter**

The Scatter plot creates x-y plots using the first two selected time series. The second time series is plotted against the first. There is an option to display the 45-degree and regression lines on the plot. If more than two time series are selected, only the first two in the time-series list will be used for this plot.



# File View

The File View analysis tool is provided as a means of viewing any ASCII file from within WDMUtil. Clicking on the **File View** button in the Analysis toolbar (or selecting the *Analysis:File* View menu item) will invoke the File Open common dialog, from which the user may specify the file to be viewed. After specifying the file name, the **File View** form will appear with the file text in a text box.



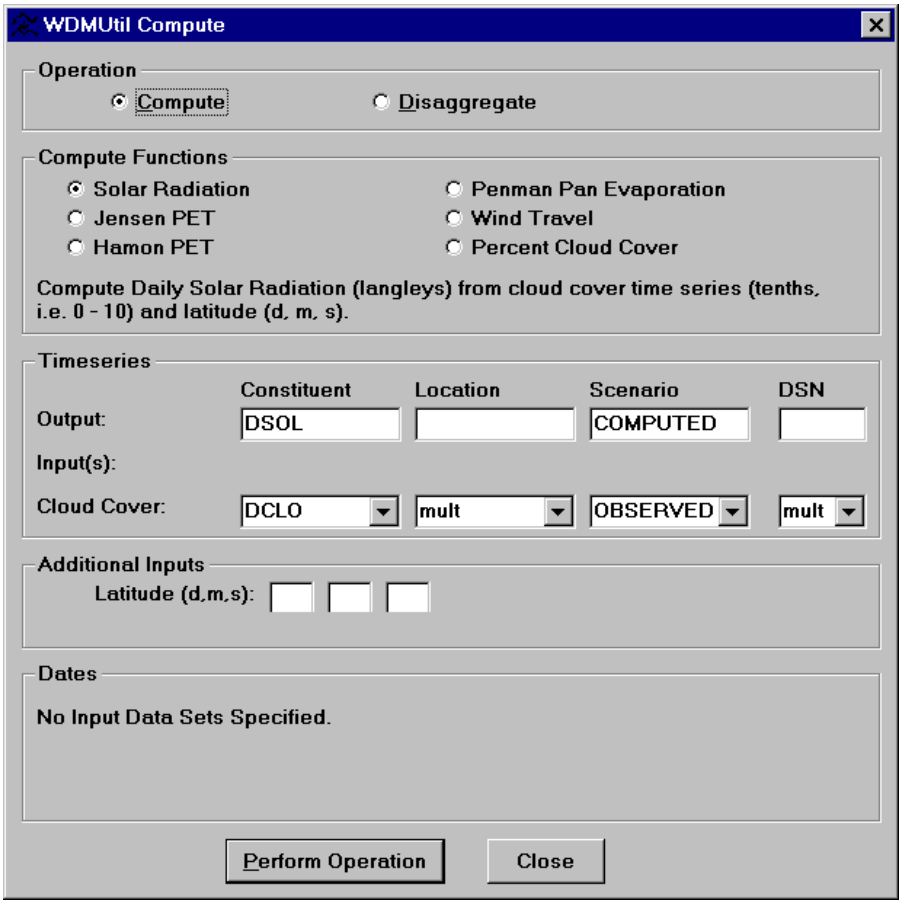
The **File View** form displays files one page at a time. At the bottom of the form is a set of buttons and a text box that are used to move through the file. The buttons are used to move forward or backward through the file. The text box is used to enter a specific page number to which to move. The field to the right of the buttons displays the total number of pages in the file. An additional list at the bottom of the form allows the user to select the format in which to view the file. The *Plain Text* option will fill each page with the maximum amount of text without using vertical scroll bars. The *FORTRAN Output* option will perform in this manner also with the exception that a new page will be formed whenever a FORTRAN carriage control character for new page is encountered. Although options for viewing in Binary and ESRI Shape File format exist, they are not used in WDMUtil. This file can be printed using the **Print** button. The **Close** button removes this form.

# Meteorological Data Transformations

WDMUtil contains two meteorological time-series transformation methods: Computing and Disaggregating. Both of these methods are accessed by clicking the **Compute/Disaggregate** button in the **Tools** frame. New data may be computed using a suite of algorithms that estimate various meteorological constituents based on existing meteorological data. New data may also be disaggregated from a daily time step to an hourly time step using the existing daily values and other associated parameters.

It is common for locations that are not near a large airport (where data collection tends to be more complete) to have a limited amount of meteorological data collected. These transformation tools provide alternative methods for developing the meteorological constituents needed for use in BASINS.

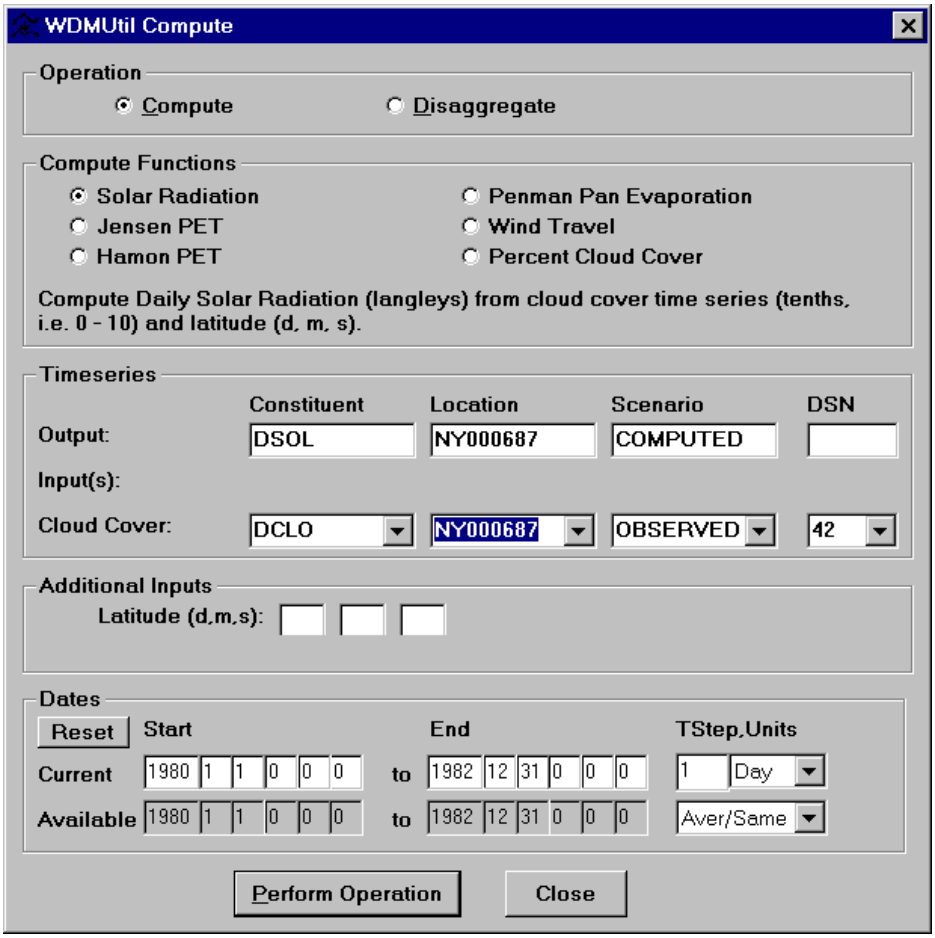
The user interface for the various compute and disaggregate options has a consistent look and feel.



The **Operation** frame is used to specify whether the user wants to Compute or Disaggregate. The next frame is named either Compute or Disaggregate Functions and contains the available compute or disaggregate functions, depending on which type of operation is being performed.

The **Time Series** frame is used to specify input and output time series needed for the operation. The number and types of input time series needed varies from one operation to another. Each input time series will have a row containing a descriptive label, lists of available constituents, locations, and scenarios, and a list of available data-set numbers. With each selection made in the lists, remaining lists are updated to contain only those time series that match the current selections. For example, if the *DCLO* (daily cloud cover) item is selected from the **Constituent** frame, the **Location**, **Scenario**, and **DSN** lists are updated to contain only items from time series which have *DCLO* as the constituent.

The *mult* displayed in the **Locations** frame indicates that there is more than one location that has a *DCLO* time series. The *OBSERVED* displayed in the **Scenarios** frame indicates that there are only *OBSERVED* time series for the *DCLO* constituent. The *mult* displayed in the **DSN** list indicates that there are still multiple data sets available for the selections made so far. If one of the available locations is now selected, a unique time series will be defined.



Note that there is now a number (42) displayed in the **DSN** list. This indicates that a unique time series has been defined through the selections made in the **Constituent**, **Location**, and **Scenario** frames. These three frames are provided to remove the burden of having to remember data-set numbers. However, if the user knows the number of the needed input time series, they may select the number from the **DSN** list at any time. The **Constituent**, **Location**, and **Scenario** frames will be updated to reflect the selected time series.

As selection of input time series is performed, updates to the output time series' specifications are made. For example, when a unique location is selected for the input time series, this is entered as the default location for the output time series. The user may overwrite these defaults. No default data-set number is specified by the program. A valid data-set number (between 1 and 9999) must be entered by the user to perform the operation. Existing time series may be overwritten, but to assure desired data are not lost, the user will be prompted to confirm this action.

When the input time series have been defined, the **Dates** frame is filled with the available period of record common to the input time series. This period may be updated by the user and will define the period over which the operation will be performed.

The **Additional Inputs** frame contains miscellaneous inputs that are needed by some of the operations. These inputs must be properly defined before the operation may be performed. If an operation does not have any inputs other than time-series data sets, the **Additional Inputs** frame will not be displayed.

The **Perform Operation** button starts the specified operation. All required fields will be checked for validity before the operation is performed. If these are all valid, the operation is performed, and a message indicates whether or not the operation was successful. If it was successful, the user is prompted to confirm that the new data should be stored on the WDM file in the specified output time series.

The Close button will close the Compute form.

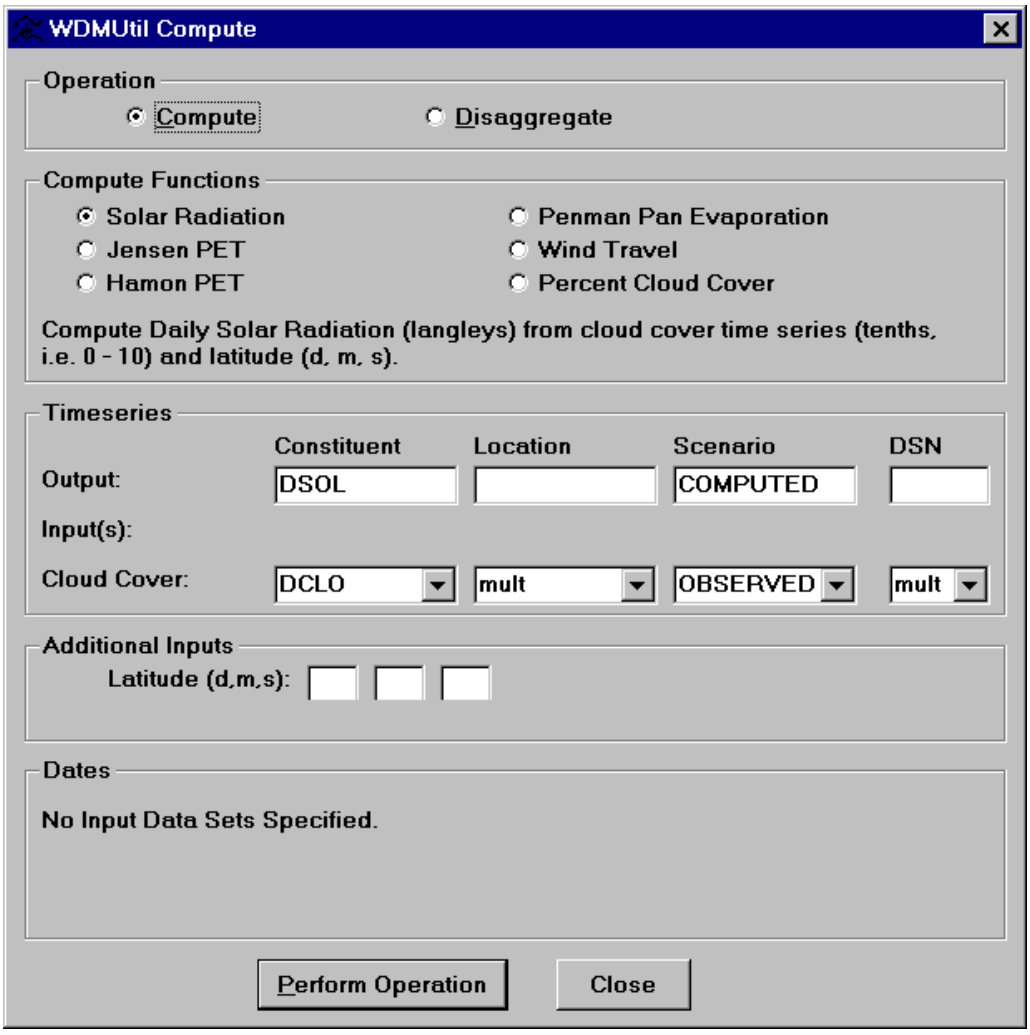
# Compute

WDMUtil contains algorithms for computing Solar Radiation, Jensen PET, Hamon PET, Penman Pan Evaporation, Wind Travel, and Cloud Cover data. The suite of algorithms for computing these data requires varying numbers and types of existing meteoric time series and associated parameters. The algorithms and data requirements may be found in the following sections that describe the different computations.

### Solar Radiation (Compute)

This procedure computes the total daily solar radiation based on empirical curves of radiation as a function of latitude (Hamon et al, 1954). The inputs are latitude in degrees and daily cloud cover in tenths (ranges from 0 to 10). This method is limited to latitudes from 25 degrees N to 50 degrees N, but this limit is not enforced by the program. The output is total daily solar radiation at the surface in langleys.

The layout of the Compute screen for Solar Radiation computation appears as follows:




Summary

Inputs:

- Latitude (degrees, minutes, seconds)
- Daily cloud cover time series (tenths, i.e., 0 - 10)

Output:

- Daily solar radiation (langleys)

### Jensen PET

This procedure generates daily potential evapotranspiration (inches) using a coefficient for the month, the daily average air temperature (F), a coefficient, and solar radiation (langleys/day). The computations are based on the Jensen and Haise (1963) formula.

```
      PET = CTS * (TAVF - CTX) * RIN

where
      PET = daily potential evapotranspiration (in)
      CTS = monthly variable coefficient
     TAVF = mean daily air temperature (F or C), computed from max-min
      CTX = coefficient
      RIN = daily solar radiation expressed in inches of evaporation

      RIN = SWRD/(597.3 - (.57 * TAVC)) * 2.54

where
     SWRD = daily solar radiation (langleys)
     TAVC = mean daily air temperature (C)
```

The following is abstracted from the PRMS manual (Leavesley, et al., 1983): As with the Hamon procedure, the Jensen-Haise procedure tends to underestimate winter PET; therefore, monthly variable CTS coefficients are included. Values of CTS and CTX for the warmer months can be estimated using regional air temperature, elevation, vapor pressure, and vegetation data (Jensen et al. 1969). For aerodynamically rough crops (assumed to include forests), CTS can be computed for the watershed by:

```
      CTS = 1/[C1 + (13.0 * CH)]

where
       C1 = an elevation correction factor
       CH = humidity index

       C1 = 68.0 - [3.6 * E1/1000]

where
       E1 = median elevation of the watershed (ft)

       CH = 50/(e2 - e1)

where
       e2 =  saturation vapor pressure (mb) for the mean maximum
air temperature for the warmest month of the year

       e1 =  saturation vapor pressure (mb) for the mean minimum
air temperature for the warmest month of the year
```

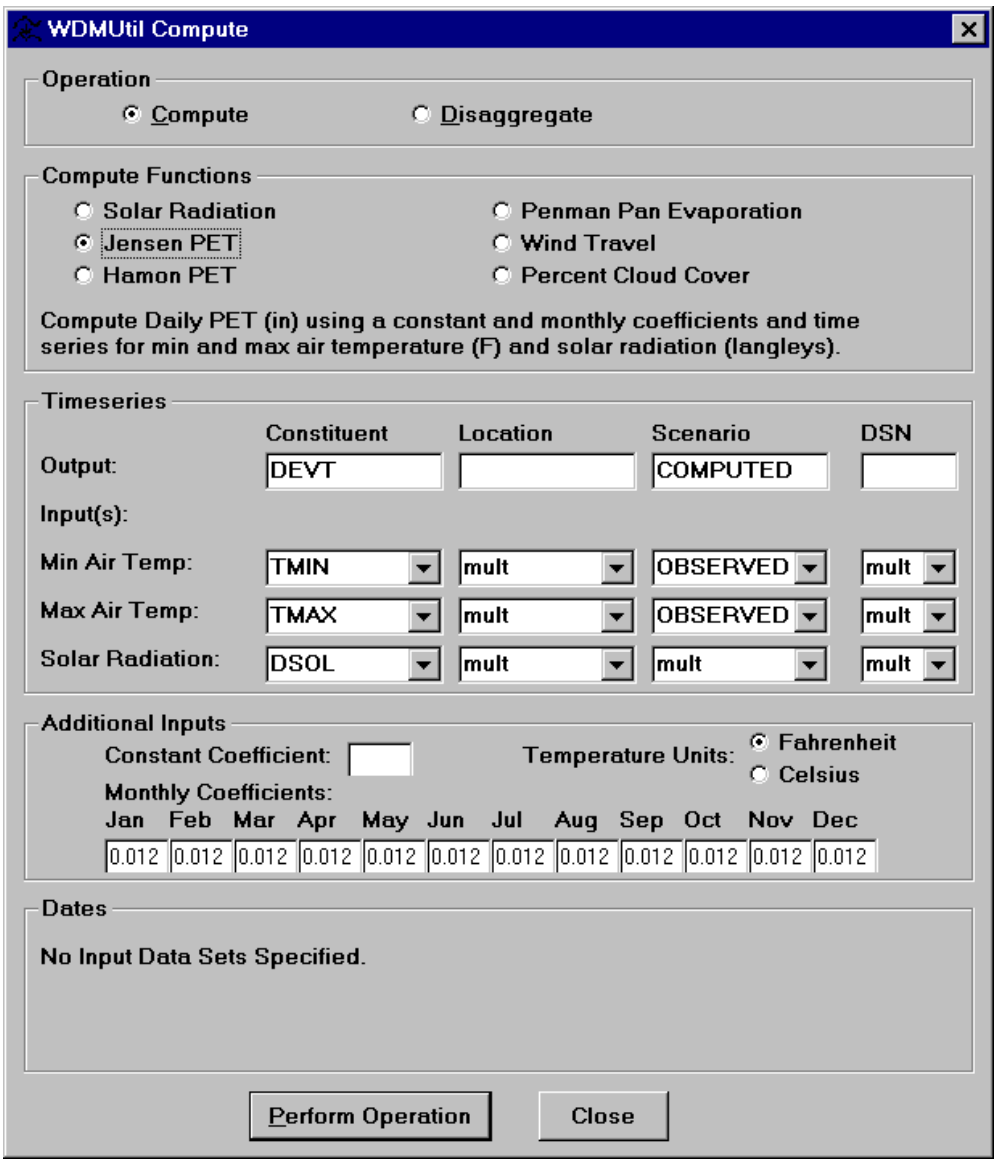
CTX is computed for each land segment as:

```
CTX = 27.5 - 0.25 * (e2 - e1) - (E2/1000)
```

where

```
E2 = median elevation of the land segment (ft)
```

The layout of the Compute screen for Jensen PET computation appears as follows:



Summary

Inputs:

- Maximum daily air temperature time series (F or C)
- Minimum daily air temperature time series (F or C)
- Total daily solar radiation time series (langleys)
- Monthly variable coefficient - CTS
- Constant coefficient - CTX

Output:

- Daily potential evapotranspiration (inches)

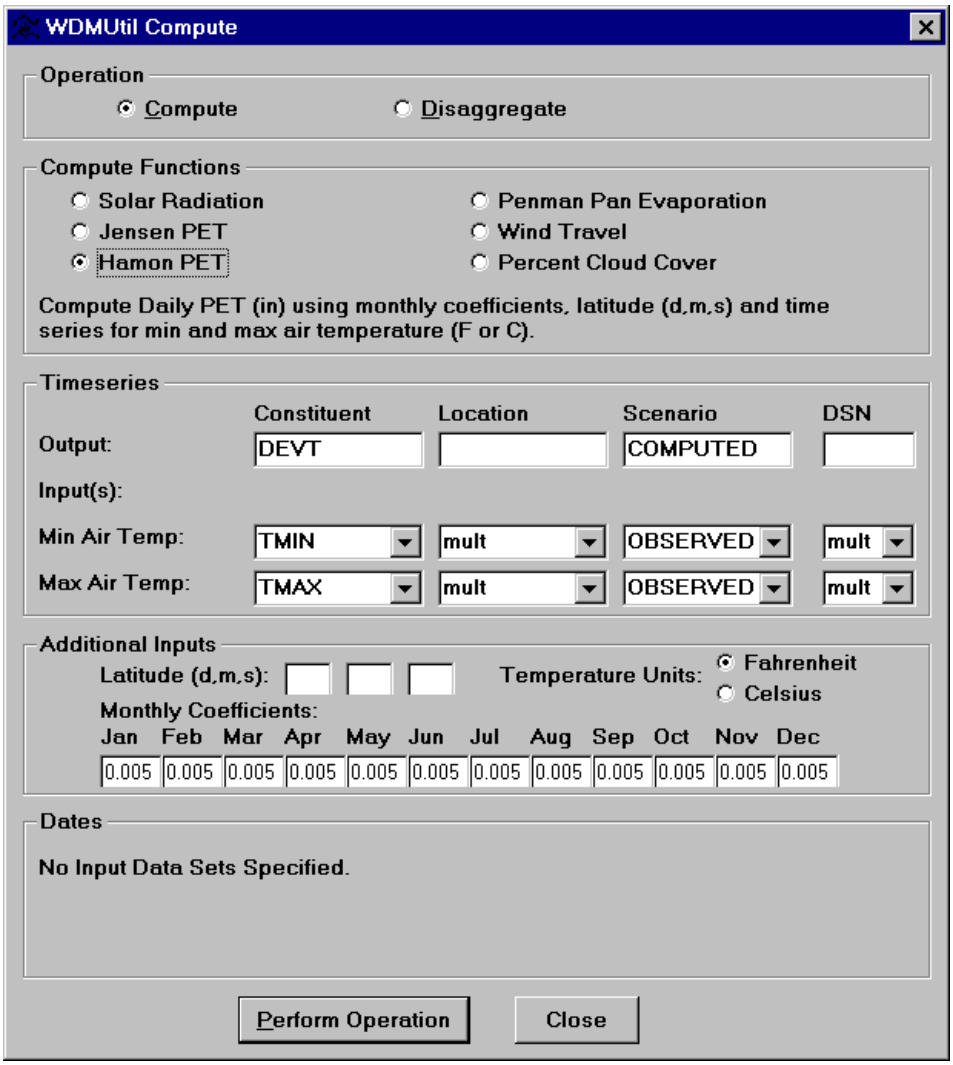
### Hamon PET

This method generates daily potential evapotranspiration (inches) using air temperature, a monthly variable coefficient, the number of hours of sunshine (computed from latitude), and absolute humidity (computed from air temperature). The computations are based on the Hamon (1961) formula.

```
      PET = CTS * DYL * DYL * VDSAT

where
      PET = daily potential evapotranspiration (in)
      CTS = monthly variable coefficient
      DYL =  possible hours of sunshine, in units of 12 hours,
computed as a function of latitude and time of year
    VDSAT =  saturated water vapor density (absolute humidity)
at the daily mean air temperature (g/cm3)

    VDSAT = (216.7 * VPSAT)/(TAVC + 273.3)

where
    VPSAT = saturated vapor pressure at the air temperature
    TAVC  =  mean daily air temperature,
computed from the daily max-min data (C)

    VPSAT = 6.108 * EXP((17.26939 * TAVC)/(TAVC + 237.3))
```

Hamon (1961) suggests a constant value of 0.0055 for CTS. However, this has been found to underestimate PET in some areas, especially for winter months. Therefore, monthly values can be specified.

The layout of the Compute screen for Hamon PET computation appears as follows:




Summary

Inputs:

- Maximum daily air temperature time series (F or C)
- Minimum daily air temperature time series (F or C)
- Latitude (D,M,S)
- Monthly variable coefficient

Output:

- Daily potential evapotranspiration (inches)

**Penman Pan Evaporation**

This procedure estimates daily pan evaporation (inches) using daily average air temperature (F), dewpoint (F), wind movement (miles/day), and solar radiation (langleys/day). The method is that of Kohler, Nordensen, and Fox (1955), and it is based on the Penman (1948) formula; the following description is abstracted from Hydrocomp (1977):

$$E = (Q*DEL + Ea*GAM)/(DEL + GAM) \quad (1)$$

where
E = pan evaporation
Q = net radiation exchange
DEL = slope of the saturation vapor pressure curve at the air temperature
GAM = 0.0105 inches Hg/deg F (defined by Bowen's Ratio)
Ea = pan evaporation (assuming air temperature equals water temperature)

To express the above equation in terms of available meteorological data, empirical curve fitting of data points is used. An empirical expression for Q*DEL, which can be treated as a single parameter, is

$$Q*DEL = \exp[(Ta - 212)\ (0.1024 - 0.01066 \ln R)] - 0.000 \quad (2)$$

where
Ta = air temperature (F)
R = daily solar radiation (langleys)

An expression for Ea is

$$Ea = (0.37 + 0.0041\ Up) * (es - ea)^{**}0.88 \quad (3)$$

where
(es - ea) = vapor pressure deficit between surface and dewpoint temperature and
Up = total daily wind movement (miles)

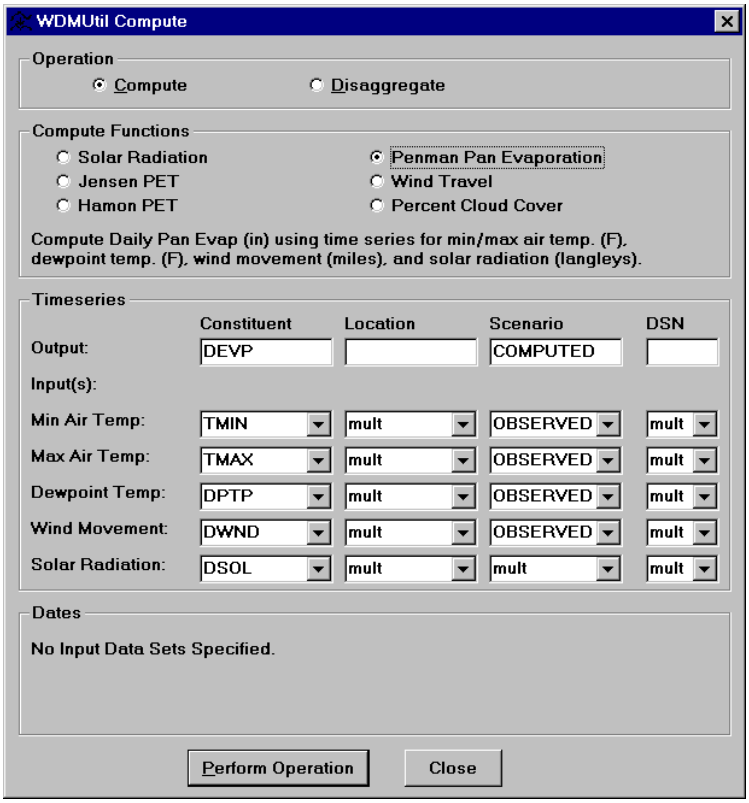
The Clausius-Clapeyron equation can be used to express e, the vapor pressure, and DEL, the slope of the saturation vapor pressure curve at air temperature Ta:

$$e = \exp\{[-7482.6/(Ta + 398.36)] + 15.674\} \quad (4)$$

$$DEL = [7482.6/Ta+398.36)^{**}2]\ \exp[15.674-7482.6/(Ta+398.36)] \quad (5)$$

To calculate evaporation, the procedure uses Eqn 1. Parameters needed for the evaluation of Eqn 1 are found using Eqns 2-5. Air temperature is estimated as the average of maximum and minimum daily temperature. If dewpoint temperatures are not available, minimum daily temperatures can be substituted.

The layout of the Compute screen for Penman Pan Evaporation computation appears as follows:




Summary

Inputs:

- Maximum daily air temperature time series (F)
- Minimum daily air temperature time series (F)
- Average daily dewpoint temperature time series (F)
- Total daily wind movement time series (miles)
- Total daily solar radiation time series (langleys)

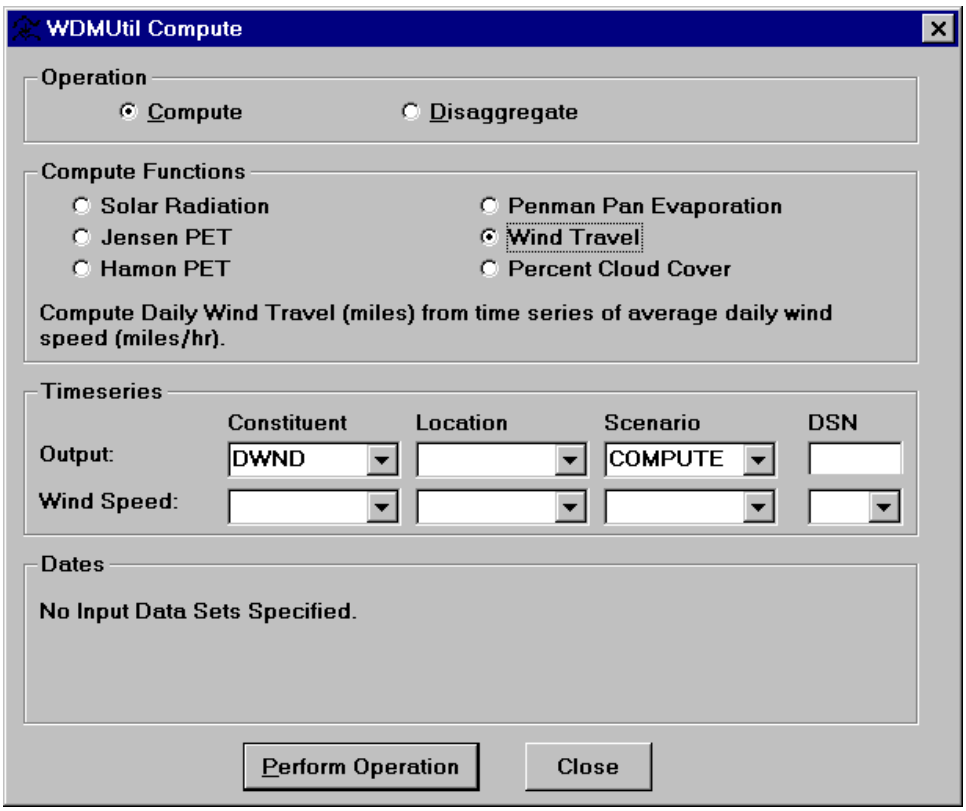
Output:

- Daily pan evaporation (inches)

### Wind Travel (Compute)

This procedure computes total daily wind travel, in miles, from average daily wind speed, in miles per hour. The average daily wind speed is multiplied by 24 to generate the total daily wind travel.

The layout of the Compute screen for Wind computation appears as follows:




Summary

Inputs:

- Average Daily Wind Speed (mph)

Outputs:

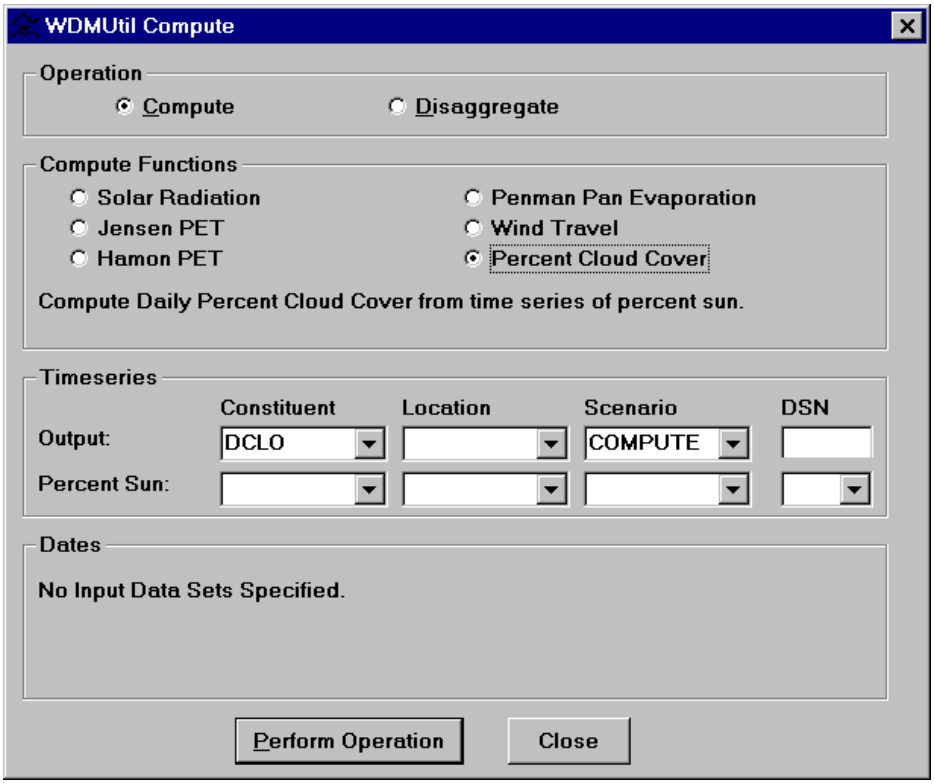
- Total Daily Wind Travel (miles)

### Cloud Cover

This procedure computes daily percent cloud cover from daily percent sunshine. The relationship between these two constituents is extracted from the algorithms developed by Hamon, Weiss, and Wilson (1954) for Solar Radiation. Specifically, the relationship is as follows:

```
      CC = 100 * (1 - PSS/100)**0.6
where
      CC = percent cloud cover
     PSS = percent sunshine
```

The layout of the Compute screen for Cloud Cover computation appears as follows:




Summary

Inputs:

- Percent Sunshine (0 - 100)

Outputs:

- Percent Cloud Cover

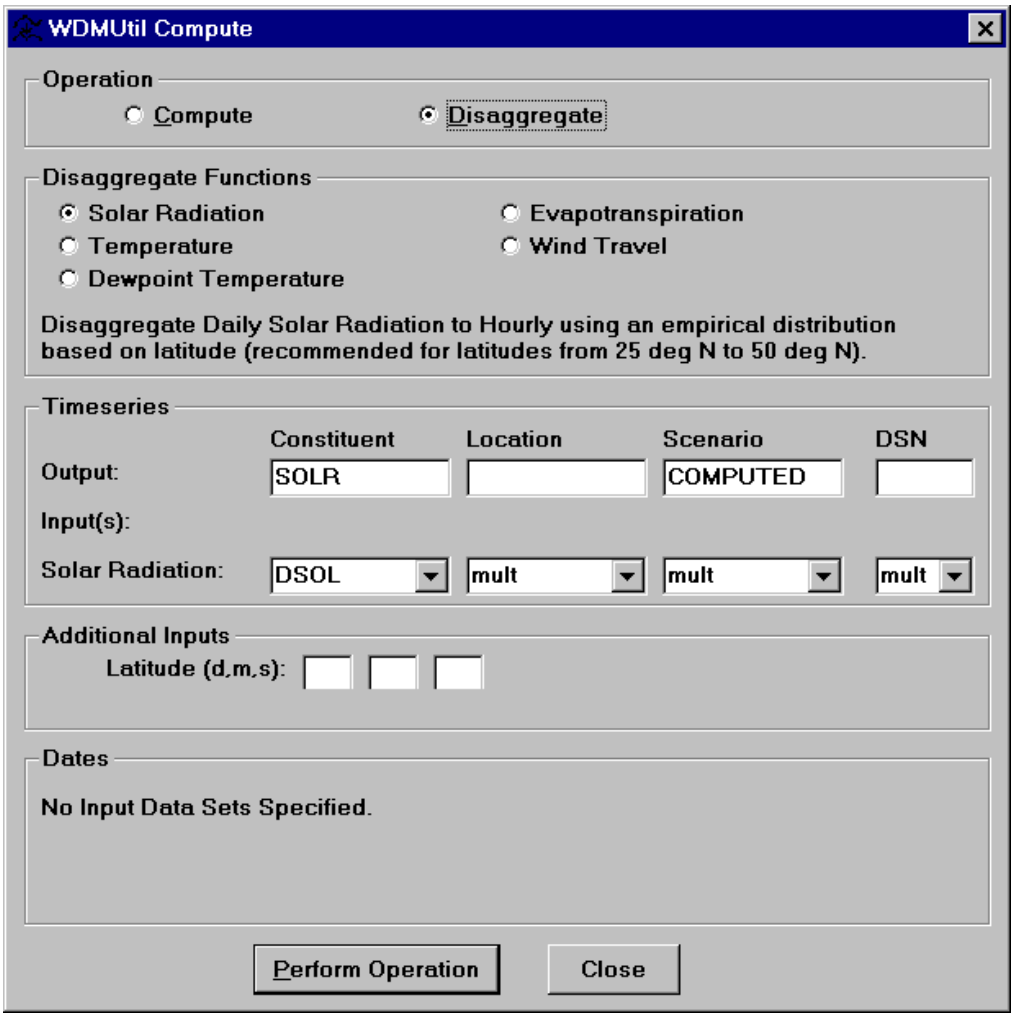
# Disaggregate

WDMUtil contains algorithms for disaggregating Solar Radiation, Temperature, Dewpoint Temperature, Evapotranspiration, Wind, and Precipitation data. The suite of algorithms for disaggregating these data requires varying types of existing meteorological time series and associated parameters. The algorithms and data requirements may be found in the following sections.

**Solar Radiation (Disaggregate)**

This procedure distributes daily solar radiation to hourly values by assuming an empirical distribution over daylight hours that are computed from latitude and time of year. It is limited to latitudes from 25 degrees N to 50 degrees N, but this limit is not enforced by the program. It is an empirical method based on work by Hamon et al. (1954).

The layout of the Compute screen for Solar Radiation disaggregation appears as follows:




Summary

Inputs:

- Daily solar radiation (langleys or any units)
- Latitude (D,M,S)

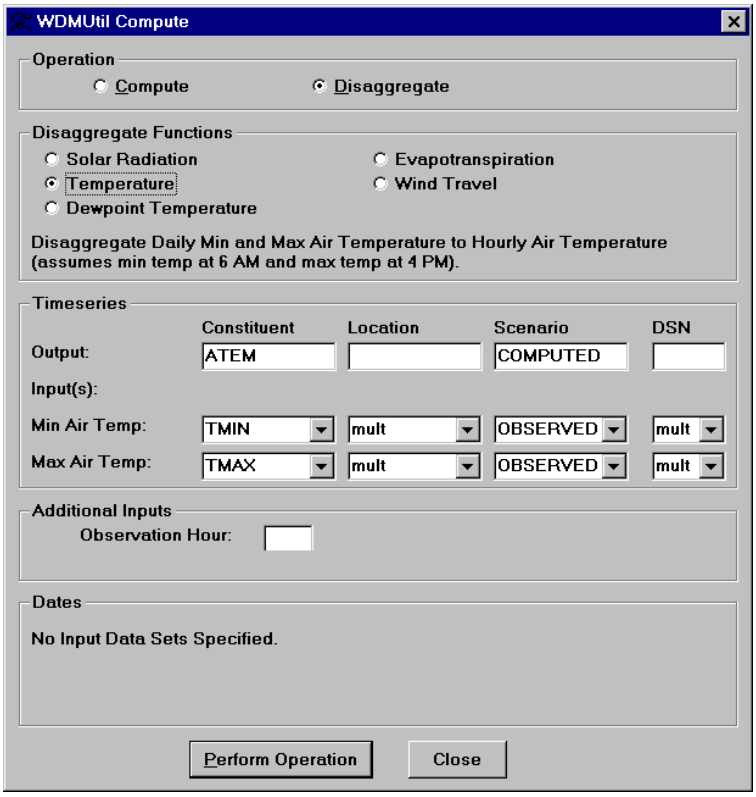
Output:

- Hourly solar radiation (same units as input)

## Temperature

This procedure distributes daily max-min temperatures to hourly values; it assumes the minimum occurs at 6 AM and the maximum occurs at 4 PM.

The layout of the Compute screen for Temperature disaggregation appears as follows:




Summary

Inputs:

- Maximum daily air temperature (F or C)
- Minimum daily air temperature (F or C)
- Observation hour (1-24) - This is the hour at which these max and min temperatures are recorded. If this hour is 17 - 24, then both the input max and min actually occurred on that day. If the hour is 6 - 16, then the input max actually occurred on the previous day. If the hour is 1 - 5, then both the input max and min actually occurred on the previous day.

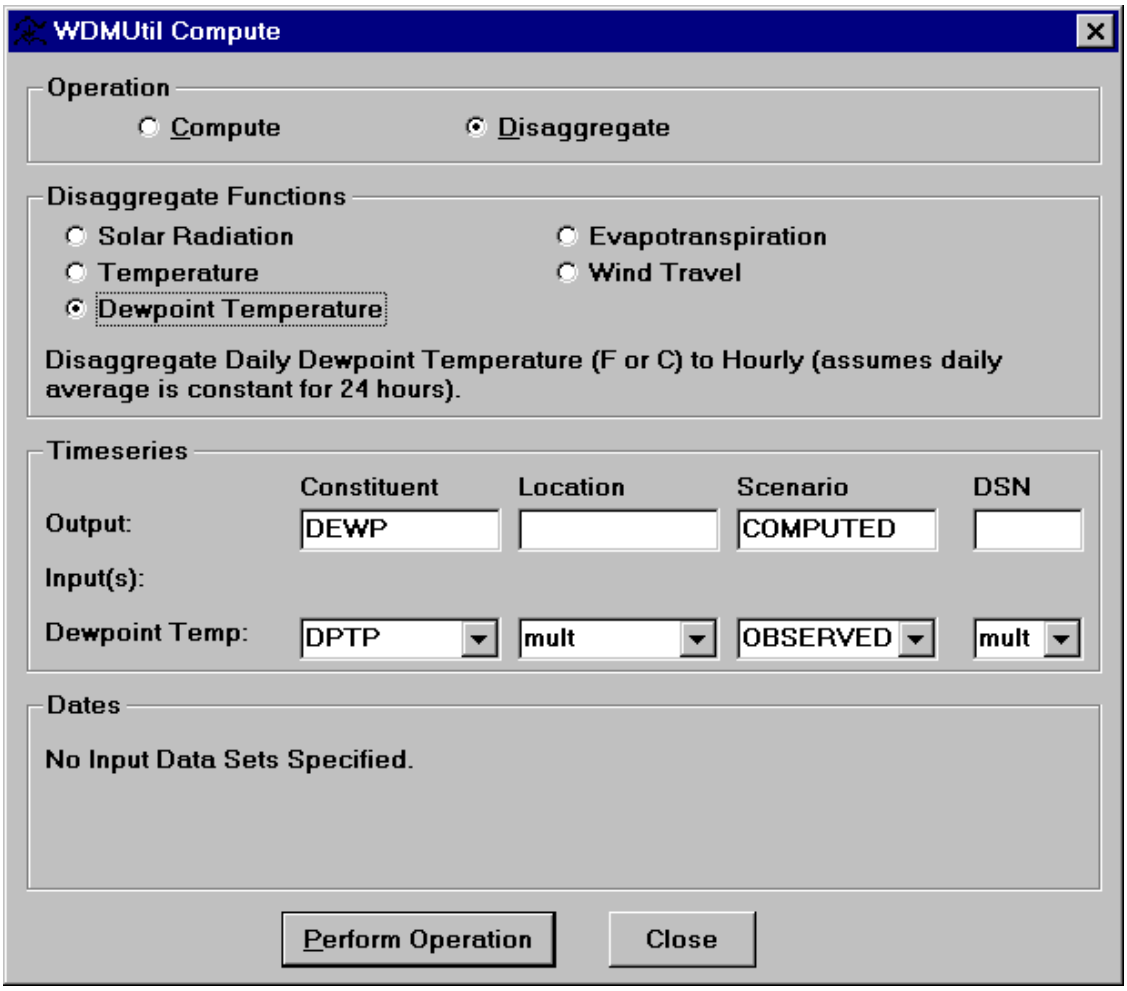
Output:

- Hourly air temperature (same as input Min/Max Temperatures)

### Dewpoint Temperature

This procedure distributes average daily dewpoint temperature to hourly values. It assumes that the daily average is constant over the 24 hour period.

The layout of the Compute screen for Dewpoint Temperature disaggregation appears as follows:




Summary

Inputs:

- Average Daily Dewpoint Temperature (F or C)

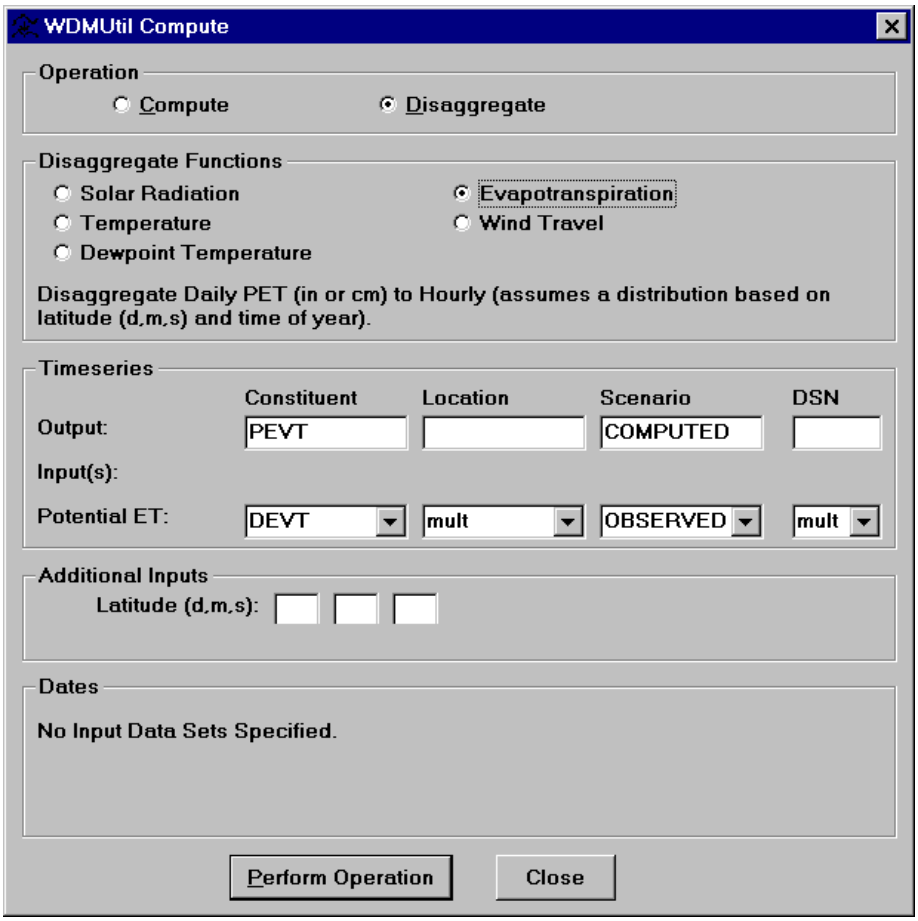
Outputs:

- Hourly Dewpoint Temperature (F or C)

## Evapotranspiration

This procedure distributes daily evapotranspiration to hourly values; it assumes a distribution based on latitude and time of year.

The layout of the Compute screen for Evapotranspiration disaggregation appears as follows:




Summary

Inputs:

- Daily PET (inches or any units)
- Latitude (D,M,S)

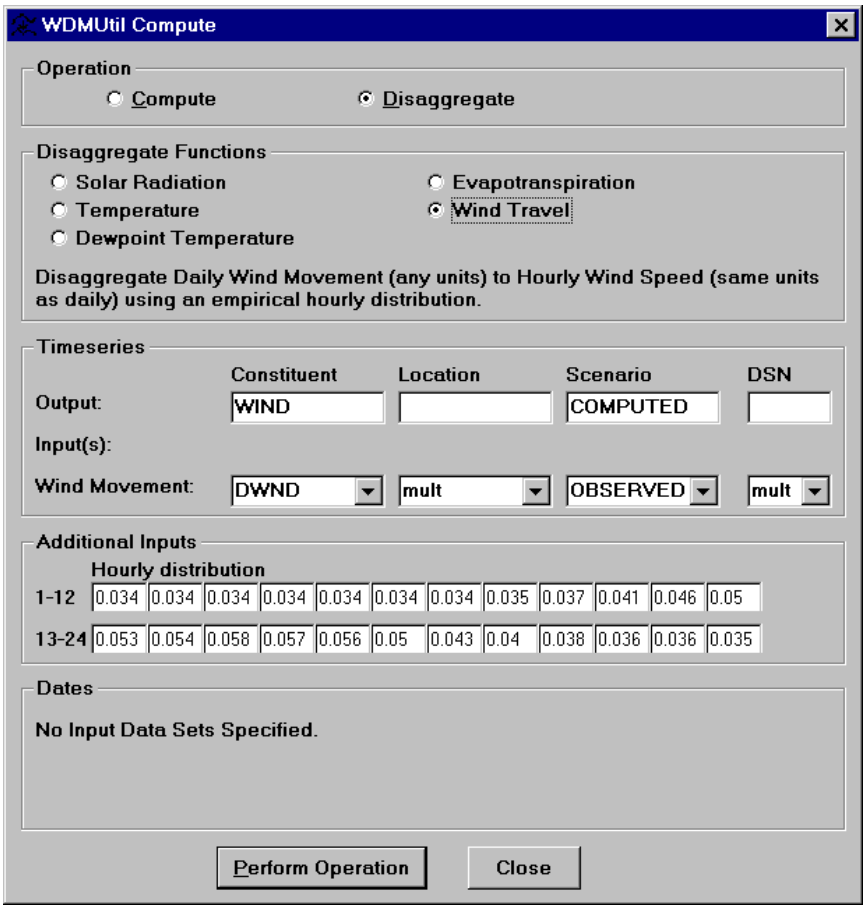
Output:

- Hourly PET (same units as input)

### Wind Travel (Disaggregation)

This procedure distributes daily wind movement to hourly values; it allows the user to adjust the default empirical hourly distribution.

The layout of the Compute screen for Wind Travel disaggregation appears as follows:




Summary

Inputs:

- Daily wind movement (any length units)
- Hourly distribution fractions (-)

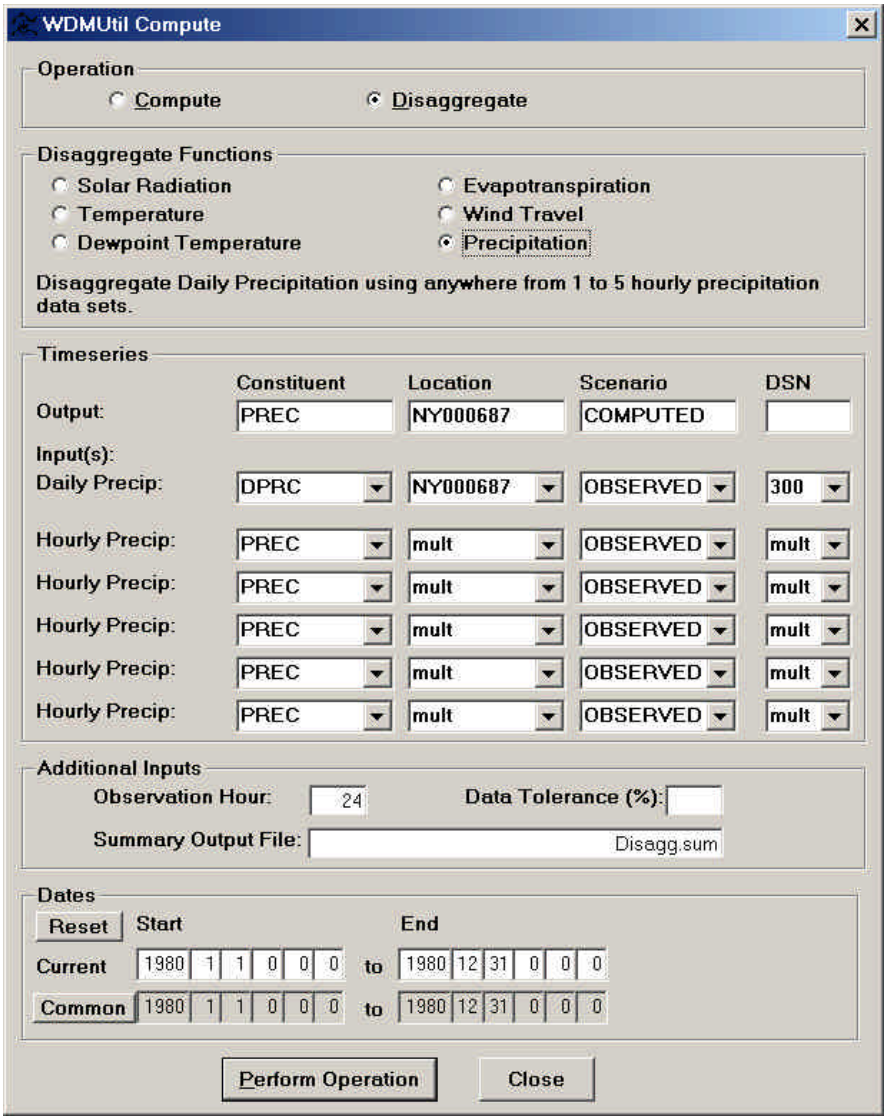
Output:

- Hourly wind movement (same units as input)

## Precipitation

This procedure distributes daily precipitation to hourly values based on hourly time series from nearby stations. The daily precipitation time series must not contain any missing periods as indicated by negative values. It distributes the data according to one of several secondary hourly stations, using the one whose daily total is closest to the daily value. If the daily total for the hourly stations being used are not within a user-specified tolerance of the daily value, the daily value is distributed using a triangular distribution centered around the middle of the day.

The layout of the Compute screen for Precipitation disaggregation appears as follows:



Summary

Inputs:

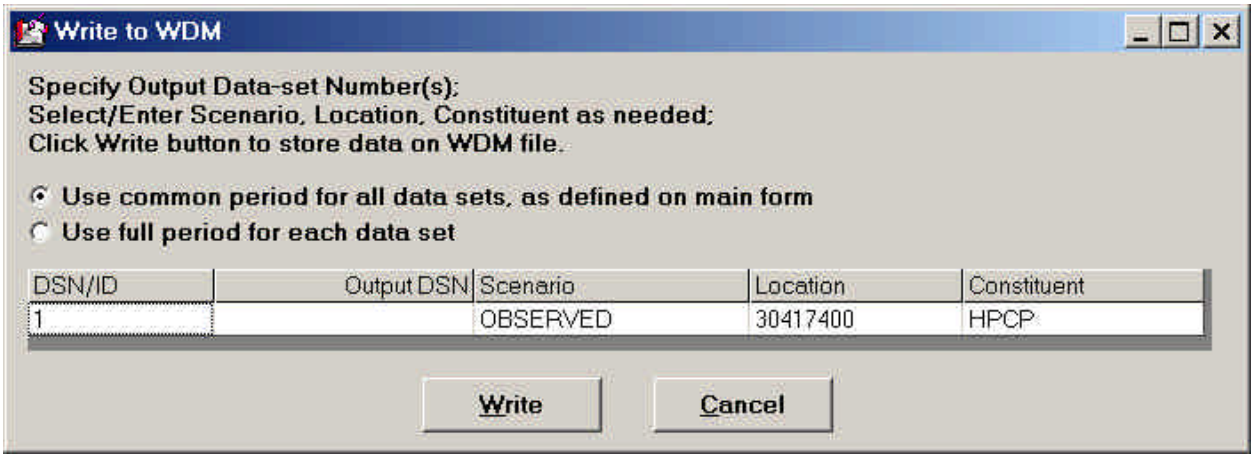
- Daily precipitation time series to be disaggregated
- Up to 5 hourly precipitation time series from nearby stations
- Observation hour of the daily precipitation time series
- A data tolerance value representing the allowable range of daily totals from the hourly stations, expressed as the absolute value of the ratio of the total to the daily value being disaggregated. One hundred percent means that any daily total (from the hourly stations) is acceptable. Zero percent means that the daily total must match the daily value exactly. Fifty percent means that the daily total must be between one half and double the daily value.
- A summary output file reporting what hourly station was used to disaggregate each daily value or that no hourly station was found to use for disaggregation.

Output:

- Disaggregated hourly precipitation time series
- Summary output file of disaggregations

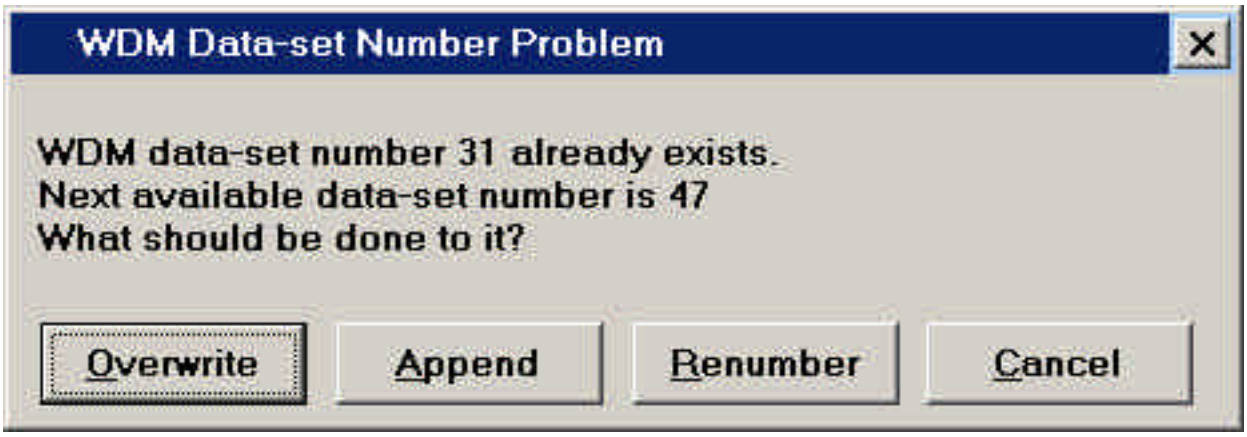
# Writing to WDM

The **Write to WDM** form is displayed by clicking on the **Write to WDM** button in the **Tools** frame or by selecting the *Analysis:Write* menu item. At least one time series must be selected from the list in the **Time Series** frame on the main form.




When more than one time series is being saved, an option is provided to save only the data in the time period common to all time series or to save the full period of data for each time series. For each selected time series, a row is created on the Write to WDM form. Each row contains fields that describe the time series. The first column displays the current id number of the time series. This value may not be modified. The second column is for specifying the time-series number to which the data will be saved on the WDM file. A valid number (1 to 9999) must be entered in this field. The remaining columns display the current Scenario, Location, and Constituent names for the data set. If needed, these values may be modified by selecting an item from the pull-down list in each field, or by typing a new value.

Clicking the **Write** button will cause each time series to be saved on the WDM file in the time-series number specified. If a specified time series already exists, the user will be several options. These include overwriting the time series, appending the data to the existing time series (overlapping time spans between the new and existing data is not allowed when appending), using the next available time-series number, or cancelling the process.



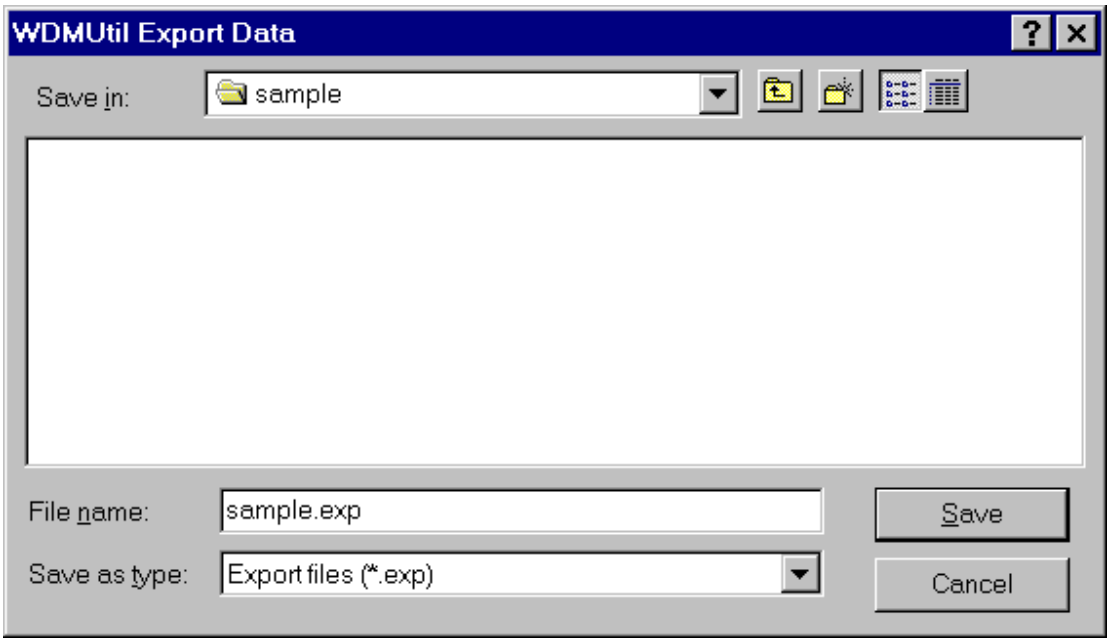

Clicking the **Overwrite** button will cause the new data to overwrite any existing data on that time series. Clicking the **Append** button will add the new values to the existing time series, assuming there is no overlapping time period between the existing and new data. Clicking the **Renumber** button will write the data to the next available time series as shown. Clicking the Cancel button will stop the writing process and return the user to the Write to WDM form.

# Generating Time Series

The **Generate** analysis tool is basically a shortcut to the New Time Series item under Time Series on the main menu. This tool generates new timeseries either from scratch or based upon existing time series. It is intended primarily for advanced users.

# Exporting Time-series Data

To export time-series data to a text file, click on the **Export** button in the **Tools** frame or select the *Analysis:Export* menu item. A single time series must be selected from the list in the **Time Series** frame on the main form. A dialogue box will prompt the user for the desired export file name.



For the selected time series, a column of data values will be output to the specified export file. Values will be output for the time period and at the time step specified in the Dates frame. A sample of the export format is shown below:

```
OBSERVED
NY000687
PREC
hourly precipitation
Date                DSN 31
1980/ 1/ 1  1       0.0000
1980/ 1/ 1  2       0.0000
1980/ 1/ 1  3       0.0000
1980/ 1/ 1  4       0.0000
1980/ 1/ 1  5       0.0000
1980/ 1/ 1  6       0.0000
1980/ 1/ 1  7       0.0000
```

# Deleting Time Series

Deleting of time series is carried out through the Delete button in the **Time Series** frame.

# References

Bicknell, B.R., Imhoff, J.C., Kittle, J.L., Jr., Donigian, A.S., Jr. and Johanson, R.C., 1997, Hydrological Simulation Program -- FORTRAN, User's manual for version 11: U.S. Environmental Protection Agency, EPA/600/R-97/080, National Exposure Research Laboratory, Athens, Ga., 755 p.

Flynn, K.M., Hummel, P.R., Lumb, A.M., and Kittle, J.L., Jr., 1995, User's manual for ANNIE, version 2, a computer program for interactive hydrologic data management: U.S. Geological Survey-Water-Resources Investigations Report 95-4085, 211 p.

France, L., Surface land daily cooperative, summary of the day TD-3200, 1998, National Climatic Data Center Publication, 32 p.

France, L., Summary of the day first order TD-3210, 1998, National Climatic Data Center Publication, 33 p.

Hammer, G., Data documentation for hourly precipitation data TD-3260, National Climatic Data Center Publication, 20 p.

Hammer, G., and Steurer, P., Data documentation for hourly precipitation data TD-3240, National Climatic Data Center Publication, 17 p.

Hamon, R.W., Weiss, L.L., and Wilson, W.T., 1954, Insolation as an empirical function of daily sunshine duration, Monthly Weather Review, Vol. 82, No. 6, (June), p 141-146.

Hamon, R.W. 1961, Estimating Potential Evapotranspiration, Proceedings of the American Society of Civil Engineers, Journal of the Hydraulic Division, Vol. 87, No. HY3, p 107-120.

Hydrocomp, 1977, Hydrocomp Water Quality Operations Manual, Hydrocomp, Palo Alto, CA.

Kittle, J.L., Jr., Lumb, A.M., Hummel, P.R., Duda, P.B., and Gray, M.H., A tool for the generation and analysis of model simulation scenarios for watersheds (GenScn): U.S. Geological Survey-Water-Resources Investigations Report 98-4134, 151 p.

Jensen, M.E. and Haise, H.R., 1963, Estimating evapotranspiration from solar radiation: Proceedings of the American Society of Civil Engineers, Journal of Irrigation and Drainage, Vol. 89, No. IR4, p 15-41.

Jensen, M.E., Rob, D.C.N., and Franzoy, C.E., 1969, Scheduling irrigations using climate-crop-soil data, National Conference on Water Resources Engineering of the American Society of Civil Engineers, New Orleans, LA, 1969, Proceedings, 20 p.

Kohler, M.A., Nordenson, T.J., and Fox, W.E., 1955, "Evaporation from Pans and Lakes," Research Paper No. 38, U.S. Weather Bureau.

Lahlou, M., Shoemaker, L., Choudhury, S., Elmer, R., Hu, A., Manguerra, H., Parker, A., 1998, User's manual for better assessment science integrating point and nonpoint sources, BASINS version 2.0, EPA-823-B-98-006.

Leavesley, G.H., Lichty, R.W., Troutman, B.M., and Saindon, L.G., 1983, Precipitation Runoff Modeling System: User's Manual, Water Resources Investigations 83-4238, U.S. Geological Survey, Denver, CO.

Lumb, A.M., Kittle, J.L., Jr., and Flynn, K.M., 1990, Users manual for ANNIE, a computer program for interactive hydrologic analyses and data management: U.S. Geological Survey Water-Resources Investigations Report 89-4080, 236 p.

Penman, H.L., April 1948, "Natural Evaporation from Open Water, Bare Soil, and Grass," Proceedings of the Royal Society of London, Ser. A, Vol. 193, No. 1032, pp. 120-145.

# Appendices

## Scripting Language

WDMUtil uses a scripting language to import all time-series data. It uses polish notation (Operator Argument Argument ...). The best way to learn how they work is to examine the sample scripts (*.ws), but this reference provides a brief summary of the various scripting language commands.

```
Command       Example

And           (And (Not EOF) (< Day 32))

ATCScript     Every scripts starts: (ATCScript “Script Description”

Attribute     (Attribute “Constituent” “PREC”)

ColumnFormat  See below

Comment       (Comment “Author: Mark Gray 8 May 2000”)

Dataset       (Dataset Scenario “OBSERVED”
                  Location Location
                  Constituent Constituent
                  Description “Summary of the Day”)

Date          (Date Year Month Repeat Hour “0”)

EOF           End of File indicator

FatalError    (FatalError “Unknown flag found”)

Fill          (Fill H 1 0 -999 -998)
              This fills in any omitted, missing, or accumulated
              values to create a constant interval dataset
              First arg is first letter of time units:
                    Century, Year, Month, Hour, minute, second
              Next arg is number of time units between values
                    (default 1)
              Next arg is value to fill in for omitted values
                    (default 0)
              Next arg is value to fill in between missing values.
                    Missing values are those set to -999 by the script
                    (default -999)
              Next arg is value to fill in between accumulated values
                    Accumulated values are those set to -998
                    (default -998)
```

```
Flag          (Flag 1) Not used by any application yet

For           (For Repeat = 1 to “31”
                   (Date Year Month Repeat)
                   (Value Value))

If            (If (= Value 999999)
                  (Value -999))

In            (If (In Value 999999 000000)
                  (Value -999))

Increment     (Increment Repeat)
              Sets Repeat = Repeat + 1

IsNumeric     (If (IsNumeric Value)
                  (Increment Repeat))

LineEnd       (LineEnd CR)
              Defines end of line
Literal       “31”
              Any string enclosed in double quotes is left alone

+ / * ^ -     (Set Repeat (+ Repeat 1))
              (Value (/ Value 100))

Mid           Not yet implemented

NextLine      (NextLine)
              Moves to the next line of the input file

Not           (While (Not EOF) ...
              Returns logical opposite of its argument (0, 1)

Or            (If (Or EOF (> Repeat 31)) ...

Set           (Set Constituent Col2)
              Assigns value of second argument to variable named
              by first argument.

Test          (Test (And (< Year 2100) (> Year 1800)))
              If the last expression within a Test returns True
              (True = 1) then this script will be highlighted.

Trim          (Set Constituent (Trim Col2))
              Evaluates to its argument without surrounding spaces

Unset         (Unset Constituent)
              Opposite of Set. Remove variable definition.

Value         (Value ValRead)
              ValRead is the name of the column from the
              column definition.  Assigns argument to data
              value in current dataset at current date.

Warn          (Warn “Uh, oh!”)
```

```
              A message box is opened, then the script proceeds.

While         (While (Not EOF) ... )
              The first argument is evaluated for truth (0 or 1).
              If true, the other arguments are evaluated (run)
              and then the loop repeats.

>             (If (> Repeats 31) ... )
>=            Comparison operators evaluate to 1 if the comparison
<             is true, 0 if it is false.
<=
<>
=
```

Fixed width ColumnFormat Example and discussion

```
  (ColumnFormat Fixed
                61-66:Value
                32-35:Year
                36-37:Month
                59-60:Hour
                9-31:Location
                55-58:Constituent
                1-8:Station
                38-42:Latitude
                43-48:Longitude
                49-54:Elevation
                59-66:Repeating)
```

For fixed width columns, the first argument is “Fixed”. All other arguments are in the format columns:name. Columns are numbered starting with 1 for the first character. Columns are either a single number indicating a single character position (perhaps a flag column) or a pair of numbers indicating a range of columns. 10-12 indicates a column that includes three characters on each line: 10, 11, and 12. 10+3 indicates the same three characters and is merely an alternate syntax for convenience.

The name which appears after the colon is how this column is referred to later in the script.

Repeating is a special column name. This is specified if there is more than one value on a line. The columns specified for Repeating are the first set of character positions that show the pattern. In the example above, 59-66:Repeating includes the colums for 59-60:Hour and 61-66:Value so both of these columns repeat. It is important to get the boundaries of Repeating correct - The character just after the end of Repeating should correspond to the first character of Repeating. For example, if 50-59:repeating is specified, that range should include the first value on the line and 60-69 should contain the second value and so on. When reading all the values on a line, the special variable Repeat is used to determine which position we are looking at.

For delimited columns, the first argument would be “Tab” or “Space” or a string of characters which are each to be treated as a delimiter. For an Excel spreadsheet saved as comma-separated values where one column is a date in the format 6/12/99, the first margument might be ,/ so the parts of the date will be separated as well as the other columns.

# Data Import Scripts - *.ws

This table summarizes the data import scripts distributed with WDMUtil. Sample data files listed in the table are also distributed.

| Script File Name | Description of Data Format Script Reads | Sample Data File |
|---|---|---|
| HPCP_NCDC_Arch.ws | Hourly Precip, Archive Format, TD-3240 | Ithaca_prec.ncd, ncdc.ncd |
| HPCP_NCDC_OL.ws | Hourly Precip, On-Line Format, NCDC TD-3240 | aberdeen.ncd |
| IdStMet_DLY.ws | Idaho State Climate Services Daily Format | fennrs.log |
| MultiCol7_Wid10_Mon.ws | Multi-Columns (7) of Width 10, Monthly Values | acpoint.prn |
| SimpDly_MDY.ws | Simple Daily Value Format-mm/dd/yyyy | usgsfecal.prn |
| SimpDly_YMD.ws | Simple Daily Value Format-yyyy/mm/dd | |
| SimpHrly_YMDH.ws | txtScriptDesc | |
| SOD_OL.ws | Summary of the Day TD-3210 | Bing_SOD.ncd |
| SOD_OL_Coop.ws | Summary of the Day, On-Line, Coop | Amherst.ncd |
| SurfAir_Hrly_Arch.ws | Surface Airways Hourly Data, Archive Format, TD-3280 | surface.ncd |
| UsgsDvWeb_MDY.WS | USGS Daily Web Values (mm/dd/yyyy) | hist_littleyellow.cgi |
| UsgsDvWeb_YMD.ws | USGS Daily Web Values (yyyy/mm/dd) | tendall.rdb |
| WDMUtil_Exp_Dly.ws | WDMUtil Export Format - Daily Values | tmax.exp |
| WDMUtil_Exp_Hrly.ws | WDMUtil Export Format - Hourly Values | prec.exp |

## HPCP_NCDC_Arch

This script reads data from the following HPCP_NCDC_Arch format:

```
(ATCScript "Hourly Precip, Archive Format, TD-3240"
  (Comment "Author: AQUA TERRA, May 2000")
  (LineEnd CR)
  (Set MVal -9.99)
  (Set MAcc -9.98)
  (ColumnFormat Fixed
                35-40:ValRead
                18-21:Year
                22-23:Month
                26-27:Day
                31-32:Hour
                33-34:Minute
                28-30:Repeats
                1-3:RecType
                4-11:Location
                4-5:State
                12-15:ElementType
                16-17:Units
                41:Flag1
                42:Flag2
                31-42:Repeating)
  (Attribute Scenario "OBSERVED")
  (Attribute Location Location)
  (Attribute Constituent ElementType)
  (Attribute Description "Hourly Precip in Inches")
  (Test (And (= RecType "HPD")
             (= ElementType "HPCP")
             (In Units "HI" "HT")
             (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (IsNumeric Hour)
             (IsNumeric Minute)
             (> Year 1700)
             (< Month 13)
             (> Day "0")
             (< Day 32)
             (< Hour 26)
             (< Minute 61))
  )
  (Attribute MVal MVal)
  (Attribute MAcc MAcc)
  (Set InMissing "0")
  (Set InAccum "0")
  (Set StartMissing "0")
  (While (Not EOF)
         (For Repeat = 1 to (- Repeats 1)
              (If (And (Not (In ValRead "999999" "99999"))
```

```
                    (Not (In Flag1 “I”))
                )
                (Date Year
                      Month
                      Day
                      Hour
                      Minute)
                (Value (/ ValRead 100))
                (If (In Flag1 “M” “D”)
                   (Value MVal)
                   (If (= 0 InMissing) (Set StartMissing 1))
                   (If (And (InMissing) (= 0 StartMissing)) (Set InMissing 0))
                   (Set StartMissing 0)
                )
                (If (In Flag1 “[” “{”) (Set InMissing 1))
                (If InMissing (Value MVal))
                (If (In Flag1 “]” “}”) (Set InMissing 0))
                (If (= Flag1 “a”) (Set InAccum 1))
                (If (And (= Flag1 “A”) (In ValRead “000000” “099999”)) (Set
InAccum 1))
                (If (And (= Flag1 “A”) (Not (In ValRead “000000” “099999”)))
(Set InAccum 0))
                (If InAccum (Value MAcc))
             )
         )
         (NextLine)
  )
  (Fill H 1 0 MVal MAcc)
)
```

The following sample lines from *ithaca_prec.ncd* demonstrate the format processed by the above script:

```
HPD30417400HPCPHI19830100010020100000000  2500000000
HPD30417400HPCPHI19830100100091700000001  1800000001  1900000002  2000000002  …
HPD30417400HPCPHI19830100110040100000001  0200000001  0300000002  2500000004
HPD30417400HPCPHI19830100140022400000002  2500000002
HPD30417400HPCPHI19830100150190100000001  0200000001  0300000003  0400000002  …
HPD30417400HPCPHI19830100160060200000001  0400000001  0500000001  1800000002  …
HPD30417400HPCPHI19830100230100200000002  0300000001  0900000004  1000000005  …
HPD30417400HPCPHI19830100240080100000001  0200000004  0300000003  0400000003  …
HPD30417400HPCPHI19830100300041700000001  1800000001  2100000001  2500000003
HPD30417400HPCPHI19830100310050100000001  0200000002  0300000002  0400000001  …
```

## HPCP_NCDC_OL

This script reads data from the following HPCP_NCDC_OL format:

```
(ATCScript “Hourly Precip, On-Line Format, NCDC TD-3240”
  (Comment “Author: AQUA TERRA, May 2000”)
  (LineEnd CR)
  (Set MVal -9.99)
  (Set MAcc -9.98)
  (NextLine 2)  (ColumnFormat Fixed
                 66-71:ValRead
                 50-53:Year
                 55-56:Month
                 58-59:Day
                 61-62:Hour
                 1-6:Location
                 61-76:Repeating
                 42-45:ElementType
                 47-48:Units
                 73:Flag1
                 75:Flag2)
  (Attribute Scenario “OBSERVED”)
  (Attribute Location Location)
  (Attribute Constituent ElementType)
  (Attribute Description “Hourly Precip in Inches”)
  (Attribute MVal MVal)
  (Attribute MAcc MAcc)
  (Test (And (= ElementType “HPCP”)
             (In Units “HI” “HT”)
             (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (IsNumeric Hour)
             (> Year 1700)
             (< Month 13)
             (> Day “0”)
             (< Day 32)
             (< Hour 26))
  )
  (Set InMissing “0”)
  (Set InAccum “0”)
  (While (Not EOF)
         (For Repeat = 1 to “24”
              (Date Year
                    Month
                    Day
                    Hour
                    “0”)
              (Value (/ ValRead 100))
              (If (In Flag1 “[” “{”) (Set InMissing 1))
              (If InMissing (Value MVal))
              (If (In Flag1 “]” “}”) (Set InMissing 0))
```

```
              (If (= Flag1 “a”) (Set InAccum 1))
              (If (And (= Flag1 “A”) (Not (In ValRead “00000” “99999”))) (Set
InAccum 0))
              (If InAccum (Value MAcc))
          )
          (NextLine)
  )
  (Fill H 1 0 MVal MAcc)
)
```

The following sample lines from *aberdeen.ncd* demonstrate the format processed by the above script:

```
COOPID,STATION NAME                ,CD,ELEM,UN,YEAR,MO,DA,TIME,HOUR01,F,F,TIME,HOUR02,F,F, …
------,------------------------------,--,----,--,----,--,--,----,------,-,-,----,------,-,-, …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,01,0100, 00000,g, ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,04,0100, 00000, , ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,10,0100, 00000, , ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,14,0100, 00000, , ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,18,0100, 00000, , ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,19,0100, 00000, , ,0200, 00010, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,24,0100, 00000, , ,0200, 00000, , , …
180015,ABERDEEN PHILLIPS FI          ,00,HPCP,HT,1984,01,30,0100, 00000, , ,0200, 00000, , , …
```

## IdStMet_DLY

This script reads data from the following IdStMet_DLY format:

```
(ATCScript "Idaho State Climate Services Daily Format"
  (Comment "Author: Mark Gray")
  (LineEnd CR)
  (ColumnFormat Fixed
                1-11:Label
                1-4:DataFlag
                12-19:Loc)
  (While (And (Not EOF) (Not (= DataFlag "====")))
      (If (In Label " LOCATION :" "LOCATION : ") (Set LocSave (Trim Loc)))
      (NextLine)
  )
  (ColumnFormat Fixed
                9-12:ValIn
                 1-4:Year
                 5-6:Month
                 7-8:Cons
                9-12:Repeating)
  (NextLine)
  (Test (And (IsNumeric ValIn)
             (IsNumeric Year)
             (IsNumeric Month)
             (> Year 1700)
             (< Month 13)))
  (Set MVal -999)
  (Fill D 1 MVal MVal -998)
  (While (Not EOF)
      (If (Isnumeric Year)
         (Dataset Scenario "OBSERVED"
                  Location LocSave
                  Constituent Cons
                  Description "Daily data")
         (For Repeat = 1 to "31"
              (Set ValRead (Trim ValIn))
              (If (= ValRead "T") (Set ValRead 0))
              (If (Not (= ValRead "M"))
                 (Date Year
                       Month
                       repeat)
                 (Value ValRead)
                 (If (= Cons "PR") (Value (/ ValRead 100)))
              )
         )
      )
      (NextLine)
  )
)
```

The following sample lines from *fennrs.log* demonstrate the format processed by the above script:

```
 ---  MAX AND MIN TEMPERATURE    ---
 LOCATION : FENN RANGER STN                              STATION NUMBER : 103143
 START YEAR : 1996      END YEAR : 1999
  *** Note *** Provisional Data *** After Year/Month 199905
 UNITS : DEGREES FAHRENHEIT
 TX-TempMax TN-TempMin TV-TempAve PR-Precip, DD-DegDys, SF-SnowFall, SD-SnowDepth, EV-Evap, WM-
WindMov, WQ-WatEqu

 M - Missing data,  T - Trace ,  S - Value for this day included in the subsequent total
 FORTRAN FORMAT : (I4, I2, A2, 31I4)
   --> (YEAR, MONTH, ELEMENT, 31 DATA VALUES)
```

| | | | | | | | | | DAY | OF | THE | MONTH | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YR | MO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | … |
| 1996 | 1TX | 35 | 36 | 35 | 49 | 35 | 36 | 38 | 34 | 39 | 36 | 46 | 49 | 40 | 46 | 37 | 37 | 40 | 39 | 32 | 33 | 35 | … |
| 1996 | 1TN | 32 | 32 | 32 | 32 | 28 | 29 | 30 | 31 | 32 | 32 | 31 | 30 | 28 | 28 | 33 | 35 | 30 | 20 | 20 | 29 | 31 | … |
| 1996 | 2TX | 26 | 25 | 26 | 29 | 36 | 38 | 35 | 35 | 38 | 45 | 46 | 51 | 50 | 52 | 52 | 53 | 52 | 44 | 49 | 45 | 55 | … |
| 1996 | 2TN | -2 | -5 | -5 | 6 | 19 | 24 | 33 | 33 | 34 | 26 | 23 | 27 | 27 | 28 | 28 | 28 | 27 | 33 | 33 | 33 | 31 | … |
| 1996 | 3TX | 47 | 53 | 58 | 37 | 47 | 43 | 43 | 53 | 58 | 58 | 55 | 56 | 53 | 60 | 66 | 48 | 57 | 57 | 64 | 70 | 56 | … |
| 1996 | 3TN | 12 | 12 | 24 | 31 | 33 | 30 | 31 | 33 | 33 | 35 | 38 | 38 | 39 | 36 | 34 | 32 | 40 | 29 | 29 | 30 | 31 | … |
| 1996 | 4TX | 58 | 54 | 53 | 56 | 65 | 76 | 76 | 83 | 88 | 71 | 51 | 57 | 53 | 57 | 68 | 64 | 61 | 59 | 49 | 56 | 46 | … |
| 1996 | 4TN | 38 | 38 | 38 | 35 | 32 | 34 | 41 | 40 | 40 | 42 | 43 | 38 | 36 | 32 | 34 | 41 | 42 | 37 | 38 | 38 | 36 | … |
| 1996 | 5TX | 67 | 56 | 50 | 56 | 58 | 65 | 67 | 67 | 65 | 66 | 70 | 66 | 74 | 62 | 62 | 58 | 63 | 71 | 70 | 57 | 66 | … |
| 1996 | 5TN | 40 | 39 | 35 | 35 | 32 | 33 | 36 | 42 | 33 | 33 | 33 | 50 | 52 | 50 | 49 | 49 | 48 | 46 | 45 | 42 | 41 | … |

### MultiCol7_Wid10_Mon

The following sample lines from *fennrs.log* demostrates the format processed by the above script:

```
(ATCScript “Multi-Columns (7) of Width 10, Monthly Values”
  (LineEnd CR)
  (NextLine)
  (ColumnFormat Fixed
                9-10:Month
                17-20:Year
                21-30:Value1
                31-40:Value2
                41-50:Value3
                51-60:Value4
                61-70:Value5
                71-80:Value6
                81-90:Value7)
  (Set Con1 GEESE)
  (Set Con2 DUCK)
  (Set Con3 DUCK-FOR)
  (Set Con4 DEER-FOR)
  (Set Con5 DEER-OTH)
  (Set Con6 RACCOON)
  (Set Con7 MUSKRAT)
  (While (Not EOF)
         (Dataset Scenario “OBSERVED”
                  Location “ACPOINT”
                  Constituent Con1
                  Description Con1)
         (Date Year Month 1 0 0)
         (Value Value1)

         (Dataset Scenario “OBSERVED”
                  Location “ACPOINT”
                  Constituent Con2
                  Description Con2)
         (Date Year Month 1 0 0)
         (Value Value2)

         (Dataset Scenario “OBSERVED”
                  Location “ACPOINT”
                  Constituent Con3
                  Description Con3)
         (Date Year Month 1 0 0)
         (Value Value3)

         (Dataset Scenario “OBSERVED”
                  Location “ACPOINT”
                  Constituent Con4
                  Description Con4)
         (Date Year Month 1 0 0)
         (Value Value4)
```

```
        (Dataset Scenario "OBSERVED"
                 Location "ACPOINT"
                 Constituent Con5
                 Description Con5)
        (Date Year Month 1 0 0)
        (Value Value5)

        (Dataset Scenario "OBSERVED"
                 Location "ACPOINT"
                 Constituent Con6
                 Description Con6)
        (Date Year Month 1 0 0)
        (Value Value6)

        (Dataset Scenario "OBSERVED"
                 Location "ACPOINT"
                 Constituent Con7
                 Description Con7)
        (Date Year Month 1 0 0)
        (Value Value7)

        (NextLine)
  )
  (Fill M 1 -999)
)
```

The following sample lines from *acpoint.prn* demonstrate the format processed by the above script:

```
Month     Year      Geese     Duck      Duck ForesDeer ForesDeer OtherRaccoon FoMuskrat
        01      19902.8639E+091.0172E+094.3594E+089.2637E+073.0879E+072.4219E+083.8750E+07
        02      19902.5868E+099.1875E+083.9375E+088.3672E+072.7891E+072.1875E+083.5000E+07
        03      19902.4769E+097.2656E+082.9063E+089.2637E+073.0879E+072.4219E+083.8750E+07
        04      19902.3970E+097.0313E+082.8125E+088.9648E+072.9883E+072.3438E+083.7500E+07
        05      19902.4769E+097.2656E+082.9063E+089.2637E+073.0879E+072.4219E+083.8750E+07
        06      19902.3970E+097.0313E+082.8125E+088.9648E+072.9883E+072.3438E+083.7500E+07
        07      19902.4769E+097.2656E+082.9063E+089.2637E+073.0879E+072.4219E+083.8750E+07
        08      19902.4769E+097.2656E+082.9063E+089.2637E+073.0879E+072.4219E+083.8750E+07
        09      19902.3970E+097.0313E+082.8125E+088.9648E+072.9883E+072.3438E+083.7500E+07
        10      19902.4769E+097.2656E+082.9063E+089.2637E+073.0879E+072.4219E+083.8750E+07
```

**SimpDly_MDY**

This script reads data from the following SimpDly_MDY format:

```
(ATCScript "Simple Daily Value Format-mm/dd/yyyy"
  (LineEnd CR)
  (ColumnFormat Fixed
                11-40:ValRead
                7-10:Year
                1-2:Month
                4-5:Day)
  (Attribute Scenario "OBSERVED")
  (Attribute Location "")
  (Attribute Constituent "")
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (> Day "0")
             (< Day 32)))
  (While (Not EOF)
         (Date Year Month Day 24 0 0)
         (Value ValRead)

         (NextLine)
  )
  (Fill "D" 1 -999 -999 -998)
)
```

The following sample lines from *usgsfecal.prn* demonstrate the format processed by the above script:

```
03/18/1999        73
04/13/1999       430
05/24/1999     82000
05/27/1999       810
07/07/1999       395
07/19/1999       800
08/01/1999     16000
08/11/1999        37
08/14/1999    170000
08/17/1999      2800
```

**SimpDly_YMD**

This script reads data from the following SimpDly_YMD format:

```
(ATCScript “Simple Daily Value Format-yyyy/mm/dd”
  (LineEnd CR)
  (ColumnFormat Fixed
                11-40:ValRead
                1-4:Year
                6-7:Month
                9-10:Day)
  (Attribute Scenario “OBSERVED”)
  (Attribute Location “”)
  (Attribute Constituent “”)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (> Day “0”)
             (< Day 32)))
  (While (Not EOF)
         (Date Year Month Day 24 0 0)
         (Value ValRead)

         (NextLine)
  )
  (Fill “D” 1 -999 -999 -998)
)
```

The following sample lines demonstrate the format processed by the above script:

```
1999/03/18        73
1999/04/13       430
1999/05/24     82000
1999/05/27       810
1999/07/07       395
1999/07/19       800
1999/08/01     16000
1999/08/11        37
1999/08/14    170000
1999/08/17      2800
```

**SimpHrly_YMDH**

This script reads data from the following SimpHrly_YMDH format:

```
(ATCScript "txtScriptDesc"
  (LineEnd CR)
  (ColumnFormat Fixed
                33-40:ValRead
                  1-8:Year
                  9-16:Month
                 17-24:Day
                25-32:Hour)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (IsNumeric Hour)
             (> Year 1700)
             (< Month 13)
             (< Day 32)
             (< Hour 26)))
  (Attribute Scenario "OBSERVED")
  (Attribute Location "ATLANTA")
  (Attribute Constituent "WIND")
  (Attribute Description "Hourly Wind at Atlanta")
  (While (Not EOF)
        (Date Year
              Month
              Day
              Hour
              "0")
        (Value ValRead)
        (NextLine)
  )
  (Fill H 1 -999 -999 -999)
)
```

The following sample lines demonstrate the format processed by the above script:

```
    1980       1       1       1  0.0000
    1980       1       1       2  0.0000
    1980       1       1       3  0.0000
    1980       1       1       4  0.0000
    1980       1       1       5  0.0000
    1980       1       1       6  0.0000
    1980       1       1       7  0.0000
    1980       1       1       8  0.0000
    1980       1       1       9  0.0000
    1980       1       1      10  0.0000
```

**SOD_OL**

This script reads data from the following SOD_OL format:

```
(ATCScript “Summary of the Day TD-3210”
  (LineEnd CR)
  (Set MVal -999)
  (Set MAcc -998)
  (ColumnFormat Fixed
                61-66:ValRead
                32-35:Year
                36-37:Month
                59-60:Hour
                9-31:Location
                55-58:Constituent
                1-8:Station
                38-42:Latitude
                43-48:Longitude
                49-54:Elevation
                59-66:Repeating)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Hour)
             (> Year 1700)
             (< Month 13)
             (< Hour 26)))
  (While (Not EOF)
         (Dataset Scenario “OBSERVED”
                  Location Location
                  Constituent Constituent
                  Description “Summary of the Day”)
         (For Repeat = 1 to “31”
              (If (<> ValRead “999999”)
                  (Set Con Constituent)
(Date Year
                   Month
                         Repeat
                         Hour
“0”)
                   (Value ValRead)
                   (If (In Con “AWND” “DPTP” “SNOW”)
                         (Value (/ ValRead 10)))
                   (If (In Con “PRCP”)
                         (Value (/ ValRead 100)))
                   (If (In Con “PRES”)
                         (Value (/ ValRead 1000)))
)
         )
         (NextLine)
  )
  (Fill D 1 MVal MVal MAcc)
)
```

The following sample lines from *Bing_SOD.ncd* demonstrate the format processed by the above script:

```
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877AWND24   16924   11624    8524   12024…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877CLDG24     024     024     024     024…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877DPNT24     824     624     924    1624…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877DPTP24   20024   16424   20724   30324…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877HTDG24    3524    3724    3424    2724…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877MNRH24    6124    4824    5124    4124…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877MXRH24    9624    7824    7524    9324…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877PKGS24 8803724 7702624 5501424 7702524…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877PRCP24     124     024     024     124…
00004725NY BINGHAMTON LINK FLD 1990 14213N07559W  4877PRES24 2802024 2843024 2844024 2813024…
```

**SOD_OL_Coop**

This script reads data from the following SOD_OL_Coop format:

```
(ATCScript “Summary of the Day, On-Line, Coop”
  (LineEnd CR)
  (Set MVal -999)
  (Set MAcc -998)
  (NextLine 2)
  (ColumnFormat Fixed
                73-78:ValRead
                61-64:Year
                65-66:Month
                68-69:Day
                6-11:Location
                53-56:Constituent
                58-59:Units
                80:Flag1
                67-82:Repeating)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (< Day 32)))
  (While (Not EOF)
         (Dataset Scenario “OBSERVED”
                  Location Location
                  Constituent Constituent
                  Description “Summary of the Day”)
         (For Repeat = 1 to “31”
              (If (Or (<> ValRead “-99999”) (= Repeat “1”))
(Date Year
                   Month
                         Day
                         “24”
“0”)
                   (If (= ValRead “-99999”) (Set ValRead MVal))
                   (Value ValRead)
                   (If (In Units “TI”)
                         (Value (/ ValRead 10)))
                   (If (In Units “HI”)
                         (Value (/ ValRead 100)))
)
         )
         (NextLine)
  )
  (Fill D 1 MVal MVal MAcc)
)
```

The following sample lines from *Amherst.ncd* demonstrate the format processed by the above script:

```
DSET COOPID WBNID STATION NAME                  CD ELEM UN YEARMO DAHR  DAY01 F F DAHR  DAY02 …
---- ------ ----- ------------------------------ -- ---- -- ------ ---- ------ - - ---- ------ …
3200 190120 99999 AMHERST                        02 DYSW NA 199701 0199 -99999 M   0299 -99999 …
3200 190120 99999 AMHERST                        02 PRCP HI 199701 0107  00007   0 0207  00011 …
3200 190120 99999 AMHERST                        02 SNOW TI 199701 0107  00013   0 0207  00015 …
3200 190120 99999 AMHERST                        02 SNWD  I 199701 0107  00001   0 0207  00003 …
3200 190120 99999 AMHERST                        02 TMAX  F 199701 0199 -99999 M   0207  00023 …
3200 190120 99999 AMHERST                        02 TMIN  F 199701 0107 -00003   0 0207 -00003 …
3200 190120 99999 AMHERST                        02 TOBS  F 199701 0107 -00003   0 0207  00023 …
3200 190120 99999 AMHERST                        02 DYSW NA 199702 0199 -99999 M   0299 -99999 …
3200 190120 99999 AMHERST                        02 PRCP HI 199702 0107  00023   0 0207  00000 …
3200 190120 99999 AMHERST                        02 SNOW TI 199702 0107  00025   0 0207  00000 …
```

**SurfAir_Hrly_Arch**

This script reads data from the following SurfAir_Hrly_Arch format:

```
(ATCScript “Surface Airways Hourly Data, Archive Format, TD-3280”
  (Comment “Author: AQUA TERRA, Feb 2001”)
  (LineEnd CR)
  (Set MVal -999)
  (Set MAcc -998)
  (ColumnFormat Fixed
                35-40:ValRead
                18-21:Year
                22-23:Month
                26-27:Day
                31-32:Hour
                33-34:Minute
                28-30:Repeats
                1-3:RecType
                4-11:Location
                12-15:ElementType
                16-17:Units
                41:Flag1
                42:Flag2
                31-42:Repeating)
  (Attribute MVal MVal)
  (Attribute MAcc MAcc)
  (Test (And (= RecType “HLY”)
             (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (IsNumeric Hour)
             (IsNumeric Minute)
             (> Year 1700)
             (< Month 13)
             (> Day “0”)
             (< Day 32)
             (< Hour 25)
             (< Minute 61))
  )
  (Set InMissing “0”)
  (Set InAccum “0”)
  (While (Not EOF)
         (Dataset Scenario “OBSERVED”
                  Location Location
                  Constituent ElementType
                  Description “Hourly Surface Airways Data”)
         (For Repeat = 1 to Repeats
              (If (<> ValRead “999999”)
                  (Date Year
                        Month
                        Day
                        (+ 1 Hour)
```

```
                    Minute)
                (Value ValRead)
                (If (In Units "HF") (Value (* ValRead 100)))
                (If (In Units "TC" "TF") (Value (/ ValRead 10)))
            )
        )
        (NextLine)
  )
  (Fill H 1 0 MVal MAcc)
)
```

The following sample lines from *surface.ncd* demonstrate the format processed by the above script:

```
HLY00013883DPTPF 19950171010240000 00043 00100 00042 00200 00042 00300 00042 00400 00042 00500…
HLY00013883DPTPF 19950171020240000 00050 00100 00049 00200 00049 00300 00049 00400 00045 00500…
HLY00013883DPTPF 19950171030240000 00028 00100 00026 00200 00028 00300 00028 00400 00029 00500…
HLY00013883DPTPF 19950171040240000 00025 00100 00023 00200 00024 00300 00023 00400 00024 00500…
HLY00013883DPTPF 19950171050240000 00014 00100 00010 00200 00008 00300 00008 00400 00008 00500…
HLY00013883DPTPF 19950171060240000 00016 00100 00015 00200 00016 00300 00017 00400 00017 00500…
HLY00013883DPTPF 19950171070240000 00046 00100 00049 00200 00060 00300 00059 00400 00058 00500…
HLY00013883DPTPF 19950171080240000 00030 00100 00030 00200 00030 00300 00029 00400 00029 00500…
HLY00013883DPTPF 19950171090240000 00029 00100 00029 00200 00028 00300 00029 00400 00026 00500…
HLY00013883DPTPF 19950171100240000 00032 00100 00033 00200 00031 00300 00030 00400 00029 00500…
```

**UsgsDvWeb_MDY**

This script reads data from the following UsgsDvWeb_MDY format:

```
(ATCScript "USGS Daily Web Values (mm/dd/yyyy)"
  (LineEnd CR)
  (ColumnFormat FIXED
                1:Comment
                3-16:StaLabel
                19-26:Loc
                19-67:Descrip
                3-10:Label
                50-57:AttVal)
  (NextLine)
  (Attribute Scenario "OBSERVED")
  (Attribute Constituent "FLOW")
  (Attribute Description "USGS Daily Flow Values")
  (While (And (Not EOF) (= Comment "#"))
      (if (= StaLabel "Station number") (Attribute Location Loc))
      (if (= StaLabel "Station name  ") (Attribute Description Descrip))
      (if (= Label "latitude") (Attribute LATDMS AttVal))
      (if (= Label "longitud") (Attribute LNGDMS AttVal))
      (if (= Label "state co") (Attribute STFIPS AttVal))
      (if (= Label "hydrolog") (Attribute HUCODE AttVal))
      (if (= Label "drainage") (Attribute DAREA  AttVal))
      (if (= Label "gage dat") (Attribute ELEV   AttVal))
(NextLine))
  (NextLine)
  (NextLine)
  (ColumnFormat TAB/
                1:Month
                2:Day
                3:Year
                4:ValRead)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (< Day 32)))

  (While (Not EOF)
     (Date Year Month (+ 1 Day) 0 0)
     (Value ValRead)
     (NextLine)
  )
  (Fill "D" 1 -999 -999 -998)
)
```

The following sample lines from *hist_littleyellow.cgi* demonstrate the format processed by the above script:

```
# US GEOLOGICAL SURVEY
# DAILY MEAN DISCHARGE DATA
#
# Station name  : Little Yellow Creek Near Strongstown, Pa.  Site 17
# Station number: 03042200
# latitude (ddmmss)..... 403345
# longitude (dddmmss)..... 0785644
# state code..... 42
# county..... Indiana
# hydrologic unit code..... 05010007
# basin name..... Conemaugh
# drainage area (square miles)..... 7.36
# contributing drainage area (square miles).....
# gage datum (feet above NGVD)..... 1600
# base discharge (cubic ft/sec)..... 180
# WATSTORE parameter code..... 00060
# WATSTORE statistic code..... 00003
# Discharge is listed in the table in cubic feet per second.
#
# Daily mean discharge data were retrieved from the
# National Water Information System files called ADAPS.
#
# Format of table is as follows.
# Lines starting with the # character are comment lines describing the data
# included in this file.  The next line is a row of tab-delimited column
# names that are Date and Discharge.  The next line is a row of tab-delimited
# data type codes that describe a 10-character-wide date (10d) and an
# 8-character-wide numeric value for discharge (8n).  All following lines are
# rows of tab-delimited data values of date (year.month.day) and discharge.
# A value of “E” or “e” in the Flags field indicates that the discharge for
# this day was estimated.  Any other values shown in this field are irrelevant.
#
# NOTE this file was requested from the NWIS-W software package
# on Mon Oct 23 14:38:55 2000
#       Dates are now in YYYY.MM.DD format.
#
# ----Date Range In File----
# 1 09/01/1960-12/06/1978
Date   Discharge    Flags
10s    8n     2s
09/01/1960   .50
09/02/1960   .40
09/03/1960   .30
09/04/1960   1.4
09/05/1960   1.7
09/06/1960   .60
09/07/1960   .40
09/08/1960   .40
09/09/1960   .60
09/10/1960   .80
```

**UsgsDvWeb_YMD**

This script reads data from the following UsgsDvWeb_YMD format:

```
(ATCScript "USGS Daily Web Values (yyyy/mm/dd)"
  (LineEnd CR)
  (ColumnFormat FIXED
                1:Comment
                3-16:StaLabel
                19-26:Loc
                19-67:Descrip
                3-10:Label
                50-57:AttVal)
  (NextLine)
  (Attribute Scenario "OBSERVED")
  (Attribute Constituent "FLOW")
  (Attribute Description "USGS Daily Flow Values")
  (While (And (Not EOF) (= Comment "#"))
      (if (= StaLabel "Station number") (Attribute Location Loc))
      (if (= StaLabel "Station name  ") (Attribute Description Descrip))
      (if (= Label "latitude") (Attribute LATDMS AttVal))
      (if (= Label "longitud") (Attribute LNGDMS AttVal))
      (if (= Label "state co") (Attribute STFIPS AttVal))
      (if (= Label "hydrolog") (Attribute HUCODE AttVal))
      (if (= Label "drainage") (Attribute DAREA  AttVal))
      (if (= Label "gage dat") (Attribute ELEV   AttVal))
(NextLine))
  (NextLine)
  (NextLine)
  (ColumnFormat TAB/.
                1:Year
                2:Month
                3:Day
                4:ValRead)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (< Day 32)))

  (While (Not EOF)
     (Date Year Month (+ 1 Day) 0 0)
     (Value ValRead)
     (NextLine)
  )
  (Fill "D" 1 -999 -999 -998)
)
```

The following sample lines from *tendall.rdb* demonstrate the format processed by the above script:

```
# US GEOLOGICAL SURVEY
# DAILY MEAN DISCHARGE DATA
#
# Station name  :  TENSAS RIVER AT TENDAL, LA
# Station number:  07369500
# latitude (degrees, minutes, and seconds)...... 322555
# longitude (degrees, minutes, and seconds)..... 0912200
# state code..................................... 22
# county code.................................... 065
# hydrologic unit code........................... 08050003
# drainage area (square miles).................   309.00
# contributing drainage area (square miles).....
# gage datum (feet above NGVD).................    50.07
# WATSTORE parameter code........................ 00060
# WATSTORE statistic code........................ 00003
# Discharge is listed in the table in cubic feet per second.
#
# Daily mean discharge data were retrieved from the
# National Water Information System files called ADAPS.
# processed into RDB table Thu Mar  9 23:50:29 EST 1995
# filter version 6.1
#
# Format of table is as follows.
# Lines starting with the # character are comment lines describing the data
# included in this file.  The next line is a row of tab-delimited column
# names that are Date and Discharge.  The next line is a row of tab-delimited
# data type codes that describe a 10-character-wide date (10d) and an
# 8-character-wide numeric value for discharge (8n).  All following lines are
# rows of tab-delimited data values of date (year.month.day) and discharge.
#
# NOTE: The header above is from an original file which has
#       has been further processed by IL-SWR web retrieval
#       software on Tue Jun 10  9:15:22 EDT 1997.
#       Dates are now in YYYY.MM.DD format.
#
# ----Date Range In File----
#  1 1936.04.01-1993.09.30
Date   Discharge
10s    8n
1936.04.01   120.00
1936.04.02   140.00
1936.04.03   130.00
1936.04.04   130.00
1936.04.05   120.00
1936.04.06   120.00
1936.04.07   120.00
1936.04.08   120.00
1936.04.09   130.00
1936.04.10   150.00
```

**WDMUtil_Exp_Dly**

This script reads Daily data from the WDMUtil Export format:

```
(ATCScript "WDMUtil Export Format - Daily Values"
  (LineEnd CR)
  (ColumnFormat Fixed
                  1-80:AttVal)
  (Attribute Scenario AttVal)
  (NextLine)
  (Attribute Location AttVal)
  (NextLine)
  (Attribute Constituent AttVal)
  (NextLine)
  (Attribute Description AttVal)
  (NextLine)
  (NextLine)
  (ColumnFormat Fixed
                  1-4:Year
                  6-7:Month
                 9-10:Day
                11-40:ValRead)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (> Year 1700)
             (< Month 13)
             (< Day 32)))
  (While (Not EOF)
        (Date Year
              Month
              Day
              "24"
              "0")
        (Value ValRead)
        (NextLine)
  )
  (Fill D 1 -999 -999 -999)
)
```

The following sample lines from *tmax.exp* demonstrate the format processed by the above script:

```
OBSERVED
NY000687
TMAX
daily maximum temperature
Date            DSN 39
1980/ 1/ 1     33.1000
1980/ 1/ 2     30.9000
1980/ 1/ 3
1980/ 1/ 4     19.9000
```

```
1980/ 1/ 5     30.9000
```

**WDMUtil_Exp_Hrly**

This script reads Hourly data from the WDMUtil Export format:

```
(ATCScript "WDMUtil Export Format - Hourly Values"
  (LineEnd CR)
  (ColumnFormat Fixed
                  1-80:AttVal)
  (Attribute Scenario AttVal)
  (NextLine)
  (Attribute Location AttVal)
  (NextLine)
  (Attribute Constituent AttVal)
  (NextLine)
  (Attribute Description AttVal)
  (NextLine)
  (NextLine)
  (ColumnFormat Fixed
                  1-4:Year
                  6-7:Month
                 9-10:Day
                12-13:Hour
                14-30:ValRead)
  (Test (And (IsNumeric ValRead)
             (IsNumeric Year)
             (IsNumeric Month)
             (IsNumeric Day)
             (IsNumeric Hour)
             (> Year 1700)
             (< Month 13)
             (< Day 32)
             (< Hour 25)))
  (While (Not EOF)
        (Date Year
              Month
              Day
              Hour
              "0")
        (Value ValRead)
        (NextLine)
  )
  (Fill H 1 -999 -999 -999)
)
```

The following sample lines from *prec.exp* demonstrate the format processed by the above script:

```
OBSERVED
NY000687
PREC
hourly precipitation
Date               DSN 31
1980/ 1/ 1  1      0.0000
1980/ 1/ 1  2      0.0000
1980/ 1/ 1  3      0.0000
1980/ 1/ 1  4      0.0000
1980/ 1/ 1  5      0.0000
1980/ 1/ 1  6      0.0000
1980/ 1/ 1  7      0.0000
1980/ 1/ 1  8      0.0000
1980/ 1/ 1  9      0.0000
1980/ 1/ 1 10      0.0000
```

## Time-Series Watershed Data Management - *.wdm

The Time-Series WDM file is a binary file designed especially for storing time-series data. A WDM file is made up of time series containg both data and attributes about the data. In order for time series to be usable by WDMUtil, they must have non-blank values for three particular WDM attributes: IDSCEN, IDCONS, and IDLOCN. When a BASINS WDM file is first read by WDMUtil, it automatically updates the attributes on the time series using information in the associated BASINS information file.

## WDMUtil Message WDM

The Message WDM file is a binary file containing information necessary for the WDM system. This file contains information regarding available attributes to be associated with time-series data. For more information about this file see the documentation for the Annie system.